The Glass Industry

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Vol. 4. JULY, 1923 No. 7

Gas Producer Practice Discussed and a Standard Method for Making Heat Balances Suggested

By William B. Chapman*

Some Remarks on a Paper Entitled "Gas Producer Practice in Steel Works,"† by Waldemar Dyrssen, United States Steel Corporation, Given Before the American Iron and Steel Institute, May 25, 1923

In going over Mr. Dyrssen's paper we were struck with the great amount of original, creative work he had done and we feel that we cannot compliment him too highly upon the monumental contribution he has made to the subject.

We believe there is one step further that Mr. Dyrssen might go in order to make his paper more practical and that is to clarify the terms which he uses so frequently and speaks of as the "gasifying temperature"; also explain how this temperature is to be ascertained. When the air blast first encounters the glowing coke at the bottom of the fire bed in a producer there is an excess of oxygen over carbon and the carbon burns to CO_2—just as in a thin fire under a boiler, and the temperatures created here are 200 or 300 degrees hotter—more or less—than those given in Mr. Dyrssen's paper; then as the CO_2 passes up, it is cooled somewhat by carbonizing, so to speak, to CO ($CO_2 + C = 2CO$). The temperature of the CO generating zone or regasification zone, referred to so often as the "gasification temperature," is limited therefore by the temperature which the first or combustion zone may have, which again depends on the melting point of the ash or clinkering tendency of the coal. The so-called "gasification temperature" evidently refers to the decomposition zone, consisting of a layer of incandescent coke which is of variable thickness. The fact that it is of variable thickness with the highest temperature at the bottom and is heated by the hot gases as they arise, proves that this temperature can only be roughly estimated as it is likewise variable from the bottom to the top, and until some practical way can be worked out for determining with fair accuracy, this average temperature, we will be handicapped in making practical application of the very ingenious method Mr. Dyrssen has suggested for testing and comparing producer operation.

We believe that by going over a number of producers and making the necessary experiments, Mr. Dyrssen can find and establish some definite relation between the highest temperature in the producer and the temperature he refers to.

In Mr. Dyrssen's paper it is assumed that there are no blow holes in the producer and that conditions are uniform and as this assumption is contrary to fact, some practical way must be found for making proper allowance for conditions as they are.

Mr. Dyrssen says that the greatest aid in helping one operate a producer would be a thermometer—more particularly a recording thermometer in the gas outlet. While we agree with him, we might interject in passing that the best producer gas we have ever seen was made in a chemical works where a bonus was paid to the man who made the highest percent of CO. The temperature test which Mr. Dyrssen refers to would be a much cheaper and easier way of judging the gas. If a recording thermometer were used and the men paid a slight bonus for keeping the temperature of the outgoing gas between a certain maximum and minimum, we believe that the cost of the recording device and the expense of keeping track of it would be paid for very quickly.

There has been no concerted attempt in this country to establish a standard for a heat balance of gas producers. A number of people have worked out a fairly complete heat balance for some isolated test but the same method and same constants have not been employed. We think it would be worth while if the institute appointed a committee to establish a standard method. The American Society of Mechanical Engineers at present has a committee that is working on something of the sort, without very much progress being made, largely due to the fact that they are trying to evolve a combination code for testing gas producers for gas engines, as well as for raw gas heating.

I have here a heat balance which Mr. Culbertson and I worked out, which we would like to present to such a com-

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† A limited number of copies of Mr. Dyrssen's paper in the form of a 67 page pamphlet, 6x9 inches, are for sale at 50 cents per copy, by the American Iron and Steel Institute, 40 Rector street, New York.

mittee, if appointed, as a suggestion of a standard method for making heat balances; I will mention only two or three points in regard to it.

In this heat balance we have not taken an isolated test of a gas producer. So often when one sees a test he has a feeling that it is exceptional and far from standard practice. We therefore took twelve different tests that were made in the four best known mechanical producers—the Hughes, the Morgan, the Wood and the Chapman. We selected what we considered to be typical tests of first class practice and averaged them together. We thus established a sort of standard of best practice in modern mechanical producers.

The average of these twelve tests shows 154 B. t. u. using of course the low or net heating values. I will not go into detail, but I want to show you where the money goes that is spent for gas producer coal. The debit side of the heat balance shows 97½ per cent of the energy put into the producer in the form of coal; the remaining 2½ per cent is in the form of steam. On the credit side there is 74.5 per cent in the form of cold producer gas and if you include the sensible heat in the gas the efficiency is increased to 86 per cent. The remaining 14 per cent is lost. The losses are approximately 12 per cent due to radiation, 1 per cent from carbon in the soot, 1 per cent due to the cooling water and ½ per cent due to carbon in the ashes.

In most producer practice it is possible to run with the outgoing gas or top temperature lower and save 5 per cent or more of the coal by cutting down radiation losses. Some people make a great fuss about a 1 per cent or less, lost in the soot; or a one-half per cent loss from carbon in the ash while at the same time there is a needless loss of 5 per cent or more in radiation due to the top of the fire bed being too hot. This heat balance shows that more can be saved by keeping the top temperature low than in any other way.

There should be as great a differential as possible between the temperature at the top of the fire bed and at the bottom; that is to say, the gas maker should put on sufficient coal to make the fire bed thick and therefore cool on top to the point where the coolness of the gas makes trouble. Usually a temperature of the outgoing gases as low as 1,200 deg. F. is easily obtainable without increasing the proportion of steam in the air blast. All that is necessary is to keep the blow-holes closed. At the bottom of the fire-bed the temperature should be as hot as possible, that is to say, as hot as the coal will stand without melting the ash; if the ash melts it is pretty sure to result in trouble with clinker, and other difficulties.

For the purpose of theoretical discussion, Mr. Dyrssen assumes horizontal uniformity across the fire-bed. This is most important. One should try as far as possible to maintain every horizontal plane across the producer uniform in two respects; it should be uniform in temperature and uniform in density. Not only in operating a producer, but in selecting a new producer it should be borne in mind that horizontal uniformity throughout the entire contents of the producer is the end to be attained for efficient operation. If the ashes are removed unevenly—as they usually are—it starts blow-holes, which destroy horizontal uniformity as regards both density and temperature. As soon as the blow-holes open the temperature rises in spots and clinkers follow —again destroying uniformity and defeating efficiency.

If efficiencies are to be improved much greater attention should be given to the question of even removal of the ashes to prevent uneven and violent disturbance in the fire-bed. The majority of troubles in a gas producer start with uneven ash removal and therefore there should be as few restrictions as possible to a free and unimpeded downward movement of the ashes. Mr. Dyrssen has mentioned with approval the new idea—at least in this country—of continuous agitation of the ash zone. We believe that continuous agitation of the ashes marks the most important immediate advance in gas producer construction.

We have been over the leading gas producers illustrated in Mr. Dyrssen's paper and find that in most every case insufficient consideration has been given to this important question of uniform ash removal. In a gas producer, efficiency and uniformity go hand in hand and one cannot obtain uniform conditions if the ashes have to be removed by a tortuous route impeded by restricted passageways. In one of the producers shown the ratio of the unimpeded space for the movement of the ashes downward to the total area of the fire-bed is 70 per cent; in the others this ratio is 49 per cent, 45 per cent, 44 per cent, 32 per cent and 18 per cent.

Mr. Dyrssen's computations are largely predicated upon a horizontally uniform gasification zone. The practical value of his proposed basis for comparing producer operation will be greatly enhanced when producers are built so that horizontal uniformity of the fire-bed and ash bed is made a practical possibility.

Mr. Dyrssen has made a statement regarding the fire-bed which in practice might be misleading. He states that a definite temperature of the off-going gas is fixed by a given coal. This is only true in regard to the minimum limit and also only when there is perfect horizontal uniformity throughout the gasifying zone. In practice no such condition exists. There are always a few blow-holes emitting CO_2, undecomposed steam and uncombined oxygen. A portion of the CO_2 might be converted into CO, and thus lower the temperature of the outgoing gases, if more coal were added at the right place. This high temperature caused by unfilled blow-holes is not fixed and does not vary with the nature of the coal. It depends partly upon the depth of the fire-bed but more upon the effectiveness of the method employed for closing the blow-holes at the top and bottom of the fire.

Lowering the temperature of the outgoing gases by decreasing the CO_2 increases their content of CH_4 and C_2H_4. This is borne out by the figures given in test 12 of Mr. Dyrssen's paper which are for a producer in which the blow-holes are closed by a horizontally operating agitator. Other things being equal the lower the top temperature (due to closing the blow-holes) the better the gas and the higher the top temperature (due to too thin and too loose a fire-bed) the poorer the gas. As Mr. Dyrssen points out elsewhere a recording pyrometer for the out-going gases would be a great aid in securing better efficiency.

Quite aside from the question of accepting Mr. Dyrssen's proposed method of testing and comparing producer operation, his paper contains so much additional data of practical value it is sure to become a standard reference on this subject for years to come.

Heat Balance of Average Gas Obtained in Test of Twelve Different Installations of Mechanical Producers

Six of the installations were of Chapman producers; two of Hughes; two of Morgan, and two of Wood. All were typical of best practice.

Compiled by W. B. Chapman, President, Chapman Engineering Company, and Proposed as Explained in the Preceding Article as a Suggestion for a Standard Method of Making Heat Balances

AVERAGE ANALYSIS OF GAS
(Taken from Tests of 12 Different Plants).

CO_2	O_2	CO	C_2H_4	H_2	CH_4	N_2	B.t.u.
4.8	0.2	25.5	0.4	12.1	3.6	53.4	154.0

Total combustibles in gas 41.6%.
Average coal fed per hour 2,816 lbs.
Average duration of tests approximately 72 hours.
Coal used—gas coal mostly from Pittsburgh district.

AVERAGE ANALYSIS OF COAL, AS FIRED
(At Same 12 Plants).

Moisture	Volatiles	Fixed Carbon	Ash	Sulphur in Ash	Total Carbon	B.t.u.
3.5	32.8	56.2	7.5	1.1	74.8	134.50

Heat Balance (summary)

Dr.	B.t.u.		
B. t. u. per lb. coal as fired	13,450	=	97.5%
Sensible heat of coal at 62°F.	0	=	0.0%
Sensible heat of steam above 62°F.	350	=	2.5%
Sensible heat of air at 62°F.	0	=	0.0%
	13,800	=	100.0%
Cr.	B.t.u.		
Calculated power of gas	10,296.4	=	74.61%
Sensible heat of gas	1,575.9	=	11.42%
Losses			
Unburned carbon in ash	47.8	=	.34%
Unburned carbon in soot (Assumed 1% of coal fired)	133.4	=	.97%
Sensible heat of ash 80°F.	0.3	=	.0 %
Sensible heat of cooling water	133.5	=	.97%
Radiation, etc. (by difference)	1,612.7	=	11.69%
	13,800.0	=	100.00%

Total losses		13.97%
EFFICIENCY OF PRODUCER, hot gas		86.03%
EFFICIENCY OF PRODUCER, cold gas		74.61%
Coal gasified per square foot per hour	35.85	lbs.
Steam used per lb. of coal	0.304	lbs.
Gas per lb. of coal as fired	66.86	cu. ft.
Air per lb. of coal as fired	3.00	lbs.
Cooling water per lb. of coal	1.78	

Temperature of gas leaving producers averaged approximately 1,250°F.
Producers equipped with 4 or 5-stage blowers with 9/16" nozzle or with steam turbo blowers.

Notes: The amount of hand poking required in producers having continuous ash removal was about 15 minutes per 8-hour or 12-hour shift, but in producers having intermittent ash removal an additional poking to settle fire after each ash removal was required. No large or objectionable clinkers were made during the tests we have selected. Carbon in soot was not measured in all of the above tests but estimated to average 1 per cent of weight of coal fired. No allowance was made for undecomposed steam in gas except in figuring air used, as practically all moisture in gas was due to moisture in coal.

No account taken and no deductions made for tar vapor in gas as practically all of it passes on into the furnace and burns with high efficiency.

No account taken of mechanical power required to operate the different producers except to note that it averaged 3 H. P.

Calculations made at or reduced to 62° F. and 30" mercury. Temperature of atmosphere at time of tests assumed to be 62° F.

United States Steel Corporation revised low values used for gases at 62° F. and 30" mercury as follows: CO 322, C_2H_4 1495, H_2 274, CH_4 909. Although the low or net values have been used in figuring the gas output they have not been used in figuring the coal and steam input. This is because the net values are practically never used for coal and steam. The correct efficiency therefore would be greater than that shown.

In several of the tests complete data was not available and had to be either estimated or omitted from the averages.

Calculations for Heat Balance

1. CALCULATION FOR VOLUME OF GAS PRODUCED FROM 1 POUND OF COAL.

	Analysis of gases having carbon		Wt. of gas in lbs. per cu. ft. @ 62° F.		Proportion by wt. of carbon in gas		Wt. of carbon per cu. ft. of gas
CO	.255	×	.074	×	12/28	=	.0081 lbs.
CO_2	.048	×	.117	×	12/44	=	.0015 "
CH_4	.36	×	.042	×	12/16	=	.0011 "
C_2H_4	.004	×	.074	×	24/28	=	.0003 "

Total lbs. of carbon per cu. ft. of gas = .0110 lbs.
Carbon in 1 lb. of coal as fired (from analysis) = .7480 "

$$\text{Volume of gas from 1 lb. of coal} = \frac{\text{c in coal} - \text{c in ash} - \text{c in soot}}{\text{c in cu. ft. of gas from anal.}}$$

$$= \frac{0.7480 - .0033 - .0092}{.0110} = 66.86 \text{ cu. ft.}$$

2. CALCULATION OF POWER OF GAS

H_2	.121	×	274	=	33.2	B.t.u.
CH_4	.036	×	909	=	32.7	B.t.u.
CO	.255	×	322	=	82.1	B.t.u.
C_2H_4	.004	×	1,495	=	6.0	B.t.u.
					154.0	B.t.u. per cu. ft.

Heat value of cold gas from 1 lb. of coal = 154.0 × 66.86 = 10,296.4 B.t.u.

3. CALCULATION FOR SENSIBLE HEAT OF GAS AT 1250°F.

	Vol. of Gas		Mean specific heat between 62°F. and 1250°F.		Increase in temp. 62°F. to 1250°F.		
CO_2	0.048	×	0.0295	×	1,188	= 1.68	B.t.u.
O_2	0.002	×	0.0189	×	1,188	= .04	"
CO	0.255	×	0.0189	×	1,188	= 5.73	"
H_2	0.121	×	0.0193	×	1,188	= 2.77	"
C_2H_4	0.004	×	0.0454	×	1,188	= .21	"
CH_4	0.036	×	0.0359	×	1,188	= 1.53	"
N	0.534	×	0.0183	×	1,188	= 11.61	"

Sensible heat of gas per cu. ft. ..... 23.57 B.t.u.
Sensible heat of gas from 1 lb. of coal = 23.57 × 66.86 = 1,575.9 B.t.u.

4. CALCULATION OF AMOUNT OF COAL GASIFIED PER SQUARE FOOT PER HOUR.

$$\frac{\text{Wt. of coal per hr.}}{\text{Producer area}} = \frac{2{,}816}{78.54} = 35.85 \text{ lbs. per sq. ft. per hr.}$$

5. CALCULATION OF SENSIBLE HEAT IN ONE POUND OF COAL.

Sensible heat in 1 lb. of coal = 0.22 (sp. ht. coal) × 0 (degrees above 62°F.) =0.0 B.t.u.

Note: This calculation is given to show method to be employed when average temperature during time of test is other than 62° F.

6. CALCULATION OF LOSS FROM UNBURNED COAL.

Ash from coal by analysis 7.5%.
Per cent. of carbon in refuse from producer 4.2%.

$$\text{Total carbon unburned per lb. of coal} = \frac{.075}{1 - 0.42} \times .042$$

$= 0.0033$ lbs.

Loss from carbon in ash = 14,500 (value of carbon) × .0033 = 47.8 B.t.u.

7. CALCULATION OF LOSS DUE TO CARBON IN SOOT.

Quantity of soot assumed to be 1% of weight of coal and to contain 8% ash and 92% carbon.

Loss of carbon in soot = .0092 × 14,500 (B.t.u. in C) = 133.4 B.t.u.

Note: It is assumed that the soot contains no tar, as the amount of condensed tar vapor is usually well under 1/10 of 1%.

8. CALCULATION OF LOSS DUE TO SENSIBLE HEAT OF ASH.

Refuse = Ash 7.5% = Carbon in ash .33% = 7.83%.
Specific heat of ash = 0.2
Temperature of ash — 80°F.
.0783 × .2 × 18 (degrees above 62°F.) = 0.28 B.t.u.

9. CALCULATION OF AMOUNT OF STEAM USED.

Diam. of nozzle = 9/16". Area of orifice = 0.25.
Steam pressure — 52 lbs. gauge — 66.7 lbs. absolute.
Napier's approximate formula steam per hour=

$$\frac{3{,}600 \times \text{absolute pressure} \times \text{orifice}}{70}$$

$$\text{Steam used per hour} = \frac{3{,}600 \times 66.7 \times 0.25}{70} = 857.4 \text{ lbs.}$$

$$\text{Pounds of steam per lb. of coal} = \frac{857.4}{2{,}816} = 0.304.$$

Note: In Napier's formula steam is assumed to be dry but it usually contains 3 per cent or 4 per cent moisture, which would make its weight somewhat greater than indicated by this formula. For exact work a throttling calorimeter should be used. The error however is offset by the fact that the steam gauge is usually located some little distance from the nozzle.

10. CALCULATION OF SENSIBLE HEAT OF STEAM.

Heat content (above 62°F.) of saturated steam at 52 lbs. gauge pressure = 1,150 B.t.u. per lb.

Sensible heat of steam = 0.304 × 1,150 = 350 B.t.u. per lb. of coal.

Note: No determination has been made of the amount of moisture in the gas. This consists of undecomposed steam from the blast and of moisture from the coal as fired. If the gas is of good quality (having under 5 per cent CO_2 and over 25 per cent CO) the moisture from undecomposed steam is small. We have assumed it to be 10 per cent of total steam used. If desired the moisture can be obtained accurately by the use of a psychrometer.

11. CALCULATION OF AMOUNT OF AIR AND SENSIBLE HEAT OF AIR.

Per cent of gas		Gas per lb. coal		Wt. gas lbs. per cu. ft		Proportion of oxygen		
0.048	×	66.86	×	0.116	×	32/44	= 0.271 lbs.	oxygen
0.255	×	66.86	×	0.074	×	16/28	= 0.721 "	"
0.002	×	66.86	×	0.084	×	1	= 0.011 "	"

Amount of oxygen in gas from 1 lb. of coal	1.003 lbs.
Amount of oxygen in 1 lb. coal (from analysis)	0.071 "
Oxygen supplied by air and steam blast	0.932 "

$$\text{Oxygen supplied by steam} = \frac{16}{18} \times .304 - 0.270.$$

Deducting 10% (assumed to be undecomposed) = 0.270 — 0.027	= 0.243 lbs.
Oxygen supplied by air blast	= 0.689 "

$$\text{Air per lb. coal, } 0.689 \times \frac{100}{25} = 3.00 \text{ lbs.}$$

3.00 × 0.2374 (sp. h. air) × 0 (degrees above 62°F.) = 0.0 B.t.u. sensible heat of air per lb. coal gasified.

Note: This calculation is given to show method to be employed whenever the average atmospheric temperature during the time the test is made is other than 62° F.

12. CALCULATION OF SENSIBLE HEAT OF COOLING WATER

10 gals. cooling water used per minute = 83.3 lbs.

$$\text{2,816 lbs. coal per hr.} = \frac{2{,}816}{60} = 46.9 \text{ lbs. per minute.}$$

$$\text{Cooling water per lb. coal} = \frac{83.3}{46.9} = 1.78 \text{ lbs.}$$

Specific heat of water = 1.0
Temperature of ingoing water 55°F., temperature of outgoing water 130°F., hence increase of temperature = 75°F.
Sensible heat in cooling water per lb. of coal = 1.78 × 75 × 1 = 133.5 B.t.u.

Recuperative Furnaces Popular in England

Discussing a paper on recuperative glass pot furnaces read by T. Teisen at a meeting of the Society of Glass Technology in London last Winter, and reported in the *Pottery Gazette and Glass Trade Review,* Prof. W. E. S. Turner said that he thought there was a great deal to justify the view the author had put forward that the recuperative furnace had come to stay, because it had come and was staying. From his own knowledge the new pot furnaces that were being installed in this country [England] were all of the recuperative type and of various good designs. He had been very much interested during a visit to Holland some time back to see no fewer than eight pot furnaces in one large works there all working under one roof in an immense glass house. The original furnaces were of the Siemens regenerative type, but one by one these were being cut out and were being replaced by the recuperative type. The manager of those works had told him that they were satisfied with the recuperative type of furnace in regard to fuel consumption, and he gathered that that was one of the reasons why the change was being made. Indeed, this manager said that the average fuel consumption was about 80 per cent of the weight of the glass worked out. In that particular works the output of glass was bulb metal with between 20 and 30 per cent lead oxide, and the system, generally speaking, was melting at night and working out during the day. The night-shift system, at least, did not encourage that simplification which was possible in other industries, whereas melting at night and working by day did give better facilities to the workman. He had also been very interested during a visit to Czecho-Slovakia to find that the manufacturers there still adhered very largely to the Siemens type of regenerative furnace, and after discussing the matter with several people there he had come to the conclusion that this was rather due to a failure to appreciate the virtues of the recuperative type of pot furnace. At the same time, after discussing the matter with people with technical knowledge and who were acquainted with the latest movements, he found that the recuperative furnace was held in high repute. For instance, he had been told that in Czecho-Slovakia the average fuel consumption, even in the best factories, with Siemens pot furnaces, was about 150 tons of fuel per 100 tons of glass, as against what was known to be the fact with recuperative furnaces, that they would run continuously with a consumption of fuel less than 100 tons per 100 tons of glass.

Electrification of the Allegheny Plate Glass Company*

By G. P. Wilson†

The art of making glass by blowing was more or less an established industry 4000 B.C. It was not, however, until 1693, when a Frenchman invented the casting of glass on a flat table, that the plate glass industry was established. The original method has not changed materially through the intervening centuries, but remains today, except in a modern style, as originally invented. It is not the purpose of this article, however, to discuss the growth of the plate glass industry, but rather to discuss its most modern developments. Very few realize the amount of work required by highly skilled workmen, the quantity of equipment and the machinery required to produce plate glass.

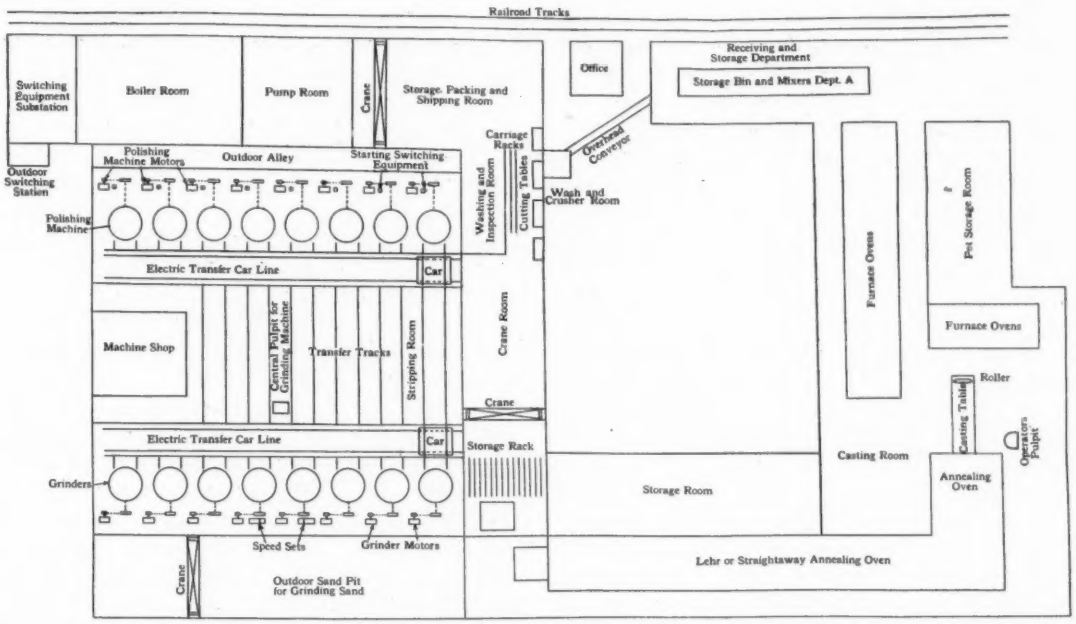

FIG. 1—LAYOUT OF THE MACHINERY AND DEPARTMENTS OF THE ALLEGHENY PLATE GLASS WORKS.

A diagrammatic sketch showing the layout of the machinery and departments of the Allegheny Plate Glass Co. at Glassmere, Pa.,[1] is shown in Fig. 1, a study of which will give some conception of the machinery involved and the different stages through which the ingredients must pass before they become a finished product. Some of the processes are quite complicated and represent considerable ingenuity. The real solutions of most of the problems have been made simple and practical by the use of electricity. There probably is no better way of giving a clear concept as to the extent electricity is used in the glass plant than briefly to trace the processes through which the ingredients must pass and how they are handled before a finished sheet of glass results.

The raw materials are contained in large storage bins. These ingredients, before entering the bin, pass over magnetized pulleys which remove any pieces of iron. At the bins, the various ingredients are weighed and measured mechanically and dumped together in a small car. This process insures uniformity in every batch of glass. The car, driven by a small motor, is run a short distance and then its contents are automatically dumped onto a conveyor which feeds the mixer. The batch is next emptied by gravity into traveling cars. These run to the furnace room and are placed on the charging crane, which moves from one furnace door to another, filling the pots by an electrically-controlled dipper. The electrification of this charging operation has greatly facilitated the method of handling the ingredients and has done away with most of the labor and discomfort to the workmen. The empty cars from the charging crane return on a separate track to the mixer and the process is repeated.

The batch is transferred to pots in which it is heated until the glass is ready to be poured on the casting table.

The molten glass, in the pot, is withdrawn from the furnace by an electrically-operated goose neck crane and carried to the casting department. The pot is here placed on a small truck which is operated by cable. The glass is then "skimmed" and the pot side and bottom thoroughly cleansed of any foreign substance that may have collected in the furnace or in transit. It is picked up from the truck by a "teeming" or pouring crane and carried to the casting table.

This casting table is a large flat steel slab approximately 16 ft. wide by 30 ft. long. The roller is of cast steel, approximately 30 in. in diameter by 16 ft. long, driven by a chain and drum attached to an electric motor.

The glass is poured onto the table just in front of the

The Electric Journal, Vol. XX, No. 4, April, 1923.

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[1] The writer wishes to acknowledge the courtesy and assistance extended him by the Allegheny Plate Glass Co., in obtaining photographs and information.

roll, which is put into motion and flattens the glass into a sheet approximately 16 ft. by 26 ft. by 0.5 in. thick. The roller is then lifted, and the glass is allowed to anneal into a solid plate (only a few seconds is required), the plate then being pushed or "stowed" automatically by an electric pusher into the first annealing oven. It is allowed to remain in this oven for eight minutes when it is again stowed into a second oven that has a slightly lower temperature. It remains here eight minutes and is stowed to a third and so on through five annealing ovens until it reaches the "elevator" station where it is placed in the long straight way "lehr" or annealing oven which is approximately 350 ft. long. The plate moves sidewise through the lehr and moves a width distance every eight minutes. This movement is accomplished by means of iron rails or bars which move upward and forward above similar stationary rails and downward and backward beneath them. The movement of these rails thus lifts the glass, carries it forward and lays it down on the stationary rails above a second duplicate moving rail which repeats the operation of the preceding set. The movement of the rail is accomplished by motor drive, the success of which is illustrated by the fact that it can pick up a big sheet of plate glass on iron rails, carry it forward and lay it down, also on iron rails without jar or force sufficient to crack or break the glass. The glass may break or crack due to an uneven annealing temperature in the lehr, but seldom if ever, due to the motor-driven rails.

Some idea of the care necessary in the annealing process may be gained when it is known that the glass enters the first annealing lehr at approximately 1,600 degrees F. and leaves the far end of the lehr at approximately 200 degrees F. This decrease in temperature has been gradual, requiring approximately three hours.

The process of casting the plate and annealing it is all accomplished by electric drive. One man operates the whole equipment required and performs about nine distinct operations for each plate cast. One plate is cast about every eight minutes. The control is located in a pulpit near the casting table, where seven separate controllers are under the care of one operator. When it leaves the lower end of the lehr, the glass is automatically placed on a transfer car. This car is electrically operated by means of a motor, with the control located apart from the car. The glass is conveyed by this car to the cutting table located in the grinding and finishing department near the lehr room. The glass is automatically transferred from the conveyor car to the cutting table. The table workmen examine it for flaws, mark any defects and cut the glass into pieces of the largest size, free from flaws or defects. Electric cranes carry the glass from the table and place it against racks in graduated stacks. From this temporary store against the rack, the glass is conveyed as needed by means of an electric crane to grinding tables.

The grinding tables are large, circular, cast-iron tables approximately 26 ft. in diameter, having four flanged street car wheels attached to their under framework, making it possible to handle them on car tracks, with rails about 12 to 14 ft. apart. Before the glass is laid on them the grinding tables are thoroughly cleaned and covered with a thin plaster of paris cement. This cement holds the glass to the table and prevents it from being thrown off during the grinding and polishing process. When the cement sets, the table is pushed onto an electric truck provided with two rails for receiving the table wheels. The table is carried on this truck to any one of the eight grinders arranged in a row along the side of the grinder and polishing room building.

On the opposite side of the building are the eight polishing machines. These are likewise served with an electric car line. The car lines for both the grinders and polishers are located in a pit of sufficient depth to permit the rails which receive the table to be at the same elevation as the rails in the floor space over which the tables are pushed from grinder to polisher or to the "stripping" room. The motor driving the transfer car is operated by a standard street car controller and it receives current from two trolley lines located in the bottom of the pit. Rails are also provided which extend from the car pit to the edge of the grinder and polishing machine framework. Each machine is provided with an adjustable track which is used to receive the table and also to raise and lower it onto the carriage of the grinder or polishing machine. These machines have a long vertical shaft, 12 or 14 in. in diameter, supported on a Kingsbury thrust bearing. The total weight of the table, carriage and grinding runners is approximately 60 tons. Attached to the vertical shaft is a large bevel gear connected to a horizontal shaft, having also a bevel gear. This shaft passes through a second gear reduction and then to a large pulley, which is belted to an electric motor. The total gear reduction is from 500 r.p.m., the speed of the motor, to 22 r.p.m., the speed of the grinding table. Since the mill has been electrified the grinding process requires approximately one hour. With the old steam engine drive which the electric motors superseded, this grinding process required more than two hours. A saving in time of over fifty per cent was effected.

The runners which actually perform the process of grinding the glass down, rest their entire weight on the glass. There are two of these runners, each of which weighs approximately 8,000 pounds, giving a total weight on the table of 16,000 pounds. These runners are not revolved by any external power, but receive their motion entirely from the friction produced as the grinder table revolves. They revolve, therefore, at somewhere near the synchronous speed of the table, but in the opposite direction. Due to the roughness of the glass, the table and runners at the beginning of the grinding process turn very slowly, about 12 or 15 r.p.m. This slow process of smoothing the rough edges and spots down lasts about five minutes. The speed is then increased to about 22 r.p.m.

The abrasive—sand and water, thoroughly mixed—which is used in the grinding process is held in a large container above the table, and is fed automatically onto the table near the center, whence it spreads out, by centrifugal force, evenly over the entire surface of the glass. This abrasive is changed during the grinding process from coarse sand to fine sand and finally to very fine emery, six or seven distinct grades of sand and emery being used before the grinding process is completed.

When the grinding process is finished, the runners are lifted, the table raised by means of the lifting truck off the

grinder machine, pushed out onto the electric truck and then onto the floor tracks. Here it is inspected, then continued across to the electric truck serving the polishing machines. This truck carries it along and places it on a polishing machine, which is a duplicate of the grinding machine except that there are a large number of runners made up of felt blocks instead of rough pieces of cast iron. These felt blocks rest on the surface of the glass and revolve as the table turns. Rouge in a liquid form is fed very slowly onto the glass at the center of table and assists materially in giving the desired fine polish to the plate. The polishing process takes about one hour and ten minutes. The speed of the polishing machines is a little higher than the grinder; they revolve at a constant speed of approximately 28 r.p.m. throughout the process.

When the polishing process is completed, the table is removed from the machine and taken to the "stripping" yard. Here the glass is removed by an electric crane, the tables cleansed of the plaster, the glass turned over and relaid and again cemented to the table, and the whole process of grinding and polishing repeated on the other side.

When the final polishing process is completed, the table is again moved to the stripping yard and stripped of the glass. The finished glass is conveyed by an electric crane to the wash rack where it is washed and dried. When this process is completed, it is again conveyed by crane to the inspection department. Here it is inspected for defects and flaws, which are marked and the sheet graded. The crane then carries the plates to a table where they are cut to size. This cutting is done by hand with an ordinary diamond cutter. The cutting tables are operated hydraulically and may be tilted to any degree between the horizontal and vertical positions. The crane again carries the glass to the hauling racks, which carry it to the ware room where another crane picks it up and stores it in sorted stacks. From the stacks it is crated ready for shipment. The electrification of this packing room has also resulted in a material saving of labor. Three or four men with the aid of the electric crane now do the work formerly done by 15 or 20, and do it with greater ease and in less time.

The foregoing description covers the entire process of making plate glass. The various processes have carried the material through the entire plant in approximately a circle. The distance traveled has been more than a half a mile. In traveling this distance, about fifteen different processes have been passed through and each movement of the glass has been accomplished by the means of electricity. The power requirements, therefore, in a completely electrified glass mill are rather large and fairly complicated.

(*To be Continued*)

Making Crystals for the Crystal Gazer*

For centuries, in the Far East, the mystic crystal gazer has been able, so it would seem, to peer steadily into the depths of a limpid sphere and thus induce a state of self-hypnotism by which the future might be revealed in a series of fleeting visions. The crystals employed for this purpose have generally been fashioned from carefully chosen pieces of fine crystal quartz. Skill of an exceptional character has been essential always in producing these perfectly formed and highly polished transparent balls.

The worker chipped the raw material roughly into the semblance of a sphere, and then by means and cunning, which he has kept as secret as possible, he gradually reduced the surface inequalities by grinding—spending a great deal of time to obtain the desired state. Next, but less laboriously, he has used suitable abrasives and polishing materials, obtaining in the end a glistening globe of marvelous perfection and water-like clearness. So much for the Asiatic artisan and his exquisite handiwork.

Down in the Monongahela Valley of West Virginia, at one of the plants engaged in the manufacture of fine pressed glassware, there is an operative who devotes many a noon hour to turning out glass spheres for the crystal gazers of the Western World. He makes a tidy sum in this way. From a pot in the furnace, he gathers sufficient molten glass on the end of an iron rod or pipe to serve his purpose; and while this glass is glowing and plastic he kneads it into a globular form by means of a wet, cup-like mold of wood which he manipulates skilfully so as to shape the hardening glass into a sphere. With this done, it is necessary only for him to separate the globe from the remaining neck of glass by a sharp blow, after which the surplus glass at that point is ground away and polished.

*From *Compressed Air Magazine*, June, 1923

HOW BALLS OF GLASS ARE NOW MADE FOR THE CRYSTAL GAZER. BEING RED HOT THE GLASS HAS PHOTOGRAPHED LIKE A SPHERE OF JET.

Lubrication of Glass Making Machinery*

Plate Glass Machinery

Probably the most prevalent lubrication problem in the manufacture of plate glass occurs on polishing machine step bearings. Owing to the necessity for fine adjustment, continuous operation, and the great weight carried (*i.e.*, approximately 60 tons), the lubricant used must be of sufficient body to insure an adequate film of oil of suitable oiliness to properly protect the bearing surfaces. The frequent installation of patent step bearings reduces the load on the oil film to a certain extent, but not enough to ever warrant the use of any but the highest grade of lubricant. For this service the latter should be a pure mineral product of the nature of cylinder oil, having a viscosity of about 160″ Saybolt at 210° F. It is best practice to run such step bearings in a bath of lubricant.

For the upper or guide bearings of the polishing machine a straight engine oil of about 200″ Saybolt viscosity at 100° F. will be suitable. This lubricant is usually applied through a force feed circulating system. The same oil is applicable to the bearings of the driving gear shaft and motor. Lubrication of the main driving (reduction) gearing should be maintained by means of a pure petroleum lubricant of sufficient body to adhere tenaciously to the teeth. If, however the lubricant is too heavy and not of the proper consistency it is apt to ball up and be thrown off by centrifugal force. A gear lubricant of 1,000″ Saybolt viscosity at 210° F. will be admirable for this purpose.

The bevel gear and pinion which serve to rotate the polishing machine can be either lubricated with the above gear lubricant, if open lubrication is desired; or, a lighter product of pure petroleum nature can be used (such as mineral cylinder oil) if the equipment is designed for automatic circulation of the lubricant. In this case the viscosity should be about 140″ to 150″ Saybolt at 210° F.

Lubrication of the grinding machine whereon the plate glass receives its preliminary treatment is similar to the lubrication of the polishing machine in most respects. On this equipment the grinding runners, which are usually of iron, are set rigidly in a circular device which is designed to rotate automatically by virtue of contact with the revolving grinding table. Two of such sets of runners are usually installed per table. The vertical guide bearings for the spindles of these runner-carrying devices require careful lubrication in order to insure against possible shut-down of a table. Usual construction calls for a plain guide bearing for the top of the spindle, with a cone bearing below. This latter generally operates in a bath of lubricant. The top bearing, however, may be hand oiled, or served by a wick feed or circulating system. On such service a medium engine oil of about 200″ Saybolt viscosity at 100° F. is suitable.

Other equipment in the plate glass plant requiring lubrication comprises the traveling mechanism on the lehrs, ironing roller mechanism, pot charging trolleys, and various overhead cranes for pouring, handling of the plates after casting, or for other purposes. In general such lubrication involves no specific problems and it can be broadly classed under two distinct headings, i.e., lubrication of (1) gears and (2) bearings. For gearing the gear lubricant specified for the polishing machine will be suitable, though in many plants the custom is to run gearing practically submerged in a bath of lighter lubricant similar to cylinder oil. For general bearing lubrication a good grade of engine oil of a viscosity from 200″ to 300″ Saybolt at 100° F. will give admirable results.

Bottle Machinery

Lubrication of the vacuum type of automatic bottle machine is perhaps the most exacting problem of this nature that confronts the glass engineer. It has been found that on this machine it is most essential that the lubricant show as low a percentage of carbon residue as possible. Otherwise a composition of burned oil and carbon will be developed to be drawn through the headers by the suction effect in gathering the glass, and accumulated in the receiver which is usually located between the bottle machine and the intake side of the vacuum pump. Ultimately a certain amount of this residue will pass into the vacuum pump cylinder, necessitating frequent cleaning of valves, cylinder head, exhaust pipe and receiver. Experience indicates that the most suitable oil for this machine is a relatively light bodied pure mineral product of from 150″ to 200″ Saybolt viscosity at 100° F., and of exceedingly low carbon residue content. In general this oil is applied by a force feed lubricating system, to the entire operating mechanism on the machine. The main spindle of this machine is supported by a step bearing, and customarily operates in a bath of oil. For this purpose a similar highly refined mineral oil of the same viscosity is most suitable. The driving mechanism which is reduction gearing, is generally bath lubricated with a fairly heavy straight mineral gear lubricant of about 1,000″ Saybolt viscosity at 210° F. On the top spindle guide bearing it is customary to use sponge grease or a medium bodied compression grease.

In the dual table bottle machine, gearing should in general be lubricated with a similar gear compound as described above; other operating parts can be well taken care of by using a straight mineral oil of about 200″ Saybolt viscosity. No essential difficulties arise in lubricating such a machine.

Window Glass Machinery

In plants where sheet glass is automatically drawn and blown, lubrication is chiefly confined to mixing equipment, carry devices, electric motors and auxiliary equipment such as air blowers, compressors and gas producers. The actual glass making equipment involves but one abnormal condition to be met by the lubricant, i.e., excessive heat. On the guide rods of the bait-carrying mechanism it is customary to use a swab of waste saturated with engine oil. Motion is slow, however, and clearances are large, so it is apparent that no decided wear could occur even though such guides were run dry. Lubrication of hoisting, carrying and elevator equipment can be classified as involving (1) gears and (2) bearings. A gear lubricant of about 1,000″ Saybolt viscosity at

*Abstracted from *Lubrication*, published by The Texas Company.

210° F. will adequately take care of straight gearing, while a lighter compound of similar nature, having a viscosity of about 120-130″ at 210° F. should be used on worm gears. A good mineral engine oil of from 200″ to 300″ Saybolt viscosity at 100° F. will be suitable for all bearings, including the ring or chain oiled type customarily installed on motors.

Where window glass is drawn directly from the melting pot and onto the flattening table, lubrication of the drawing machine and rolls is an important question. Due to the high temperature encountered all such bearings and operating mechanism should be lubricated with a high flash point product of pure petroleum nature having a low degree of evaporation. Normally these temperatures average about 600° F.

For worm driving and bevel gear mechanism a straight mineral product should be used, having a viscosity of from 120″ to 130″ Saybolt at 210° F. Other operating mechanism and bearings can usually be properly served by a good light engine oil of about 200″ Saybolt at 100° F. or sponge grease where compression grease cup lubrication is desired.

Pressing Machinery

Lubrication of glass pressing equipment is in general carried out by automatic means, or the machines are so designed that bath or splash lubrication will be possible. In the wide mouth bottle press the operating gearing usually runs submerged in a bath of oil in the base of the machine. Certain types of these machines in addition are equipped with an oil pump, filter and adjustable sight feed lubricators, and the process of lubrication of other working parts is continuous and automatic.

For the lubrication of such gearing a straight mineral oil of about 120″ Saybolt viscosity at 210° F. will be suitable. Where automatic lubricating systems are installed a good grade of light engine oil, having a viscosity of 200″ to 300″ Saybolt at 100° F. should be used.

The table carrying the molds is usually of revolving type, mounted on steel ball bearings. On such service a light bodied compression cup grease or a lubricant of petrolatum nature is most suitable. On the other hand, some operators prefer to flood the raceway for the ball bearings with a fairly heavy grade of engine oil.

In the modern glass press it is customary to lubricate the air cylinders and other pertinent parts with which the air comes in contact, by impregnating this air with lubricant as it enters the machine. To accomplish this an automatic sight feed lubricator is usually installed in the main air supply line. Thus the air stream in its passage through the machine carries the necessary lubricant to serve the valves and cylinders, to cool, clean and lubricate the shear blades, and clean and lubricate the blank molds. In addition where certain of the rotating mechanism is operated by air, the oil it contains lubricates these parts and prevents to a large extent the accumulation of crushed glass.

Auxiliary Machinery

There is a certain amount of equipment which will normally be common to almost every plant where glass is manufactured by machinery. Under this classification would be included the hoisting, conveying and crushing devices necessary for mixing of the raw ingredients, air compressors and blowers required for furnishing the air for blowing, or operating certain of the equipment in lieu of steam or electricity, gas producers for the generation of gas for fuel purposes, where adjacent supplies of natural or artificial gas are inadequate, and the lubrication of steam cylinders.

Mixing Equipment

Lubrication of the customary mechanism involved in mixing can in general be regarded from the same viewpoint as the lubrication of window glass blowing equipment, *i.e.*, as including (1) gears, and (2) bearings. Under normal conditions the same grades of lubricants will be satisfactory as recommended above. On account of the amount of dust usually present, steps should be taken wherever possible to protect gears and pinions with suitable housings, and bearing oil-ways with waste pads or covers, unless automatic lubrication is possible. In addition such operating mechanisms should be inspected regularly, kept as clean as possible and oiled rather more freely than usual.

Compressors

Inasmuch as compressed air is frequently the medium for operating certain of the glass handling mechanism, the lubrication of air compressors becomes, therefore, an important factor. When designed for crankcase lubrication, a medium non-emulsificable oil of about 180″ Saybolt viscosity should be used. Other designs of compressors such as the locomotive type, etc., will simply involve the lubrication of air cylinders usually using a straight pale mineral oil of 200″ Saybolt at 100° F.

Blowers

Lubrication of air blowers is chiefly a matter of oiling bearings. For this service a good engine oil of from 300″ to 500″ Saybolt viscosity at 100° F. will be suitable, whether hand oiling, sight feed oil cups or ring or chain oiling is customary. In crankcase and splash oiling systems the lubricants used for compressors is recommended.

Gas Producers

The lubrication of gas producers, which are necessary adjuncts to many plants, is confined chiefly to the rotating mechanism involving gearing and accessory bearings. The same recommendations hold in this case as given under window glass machinery.

Conclusion

Owing to the magnitude of the glass making industry, especially in regard to specialties, it has been possible to treat only the manufacture of the more commonly used products in detail. It is in these processes, however, that problems in lubrication will most usually be encountered, and therefore they are of paramount interest to the engineer. In fact the manufacture of glass specialties involves little or no intricate machinery and hand operations still exist more than anywhere else in the industry.

It can be appreciated that due to the usually abnormal conditions under which lubrication must be carried out, the possibility of faults arising in this phase of plant operation is almost always present. Conditions conducive to breakdowns exist so generally that the utmost care should always be observed in the original selection of the lubricant, and in its subsequent application.

The Glass Industry

The First Technical Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials, and Glass Factory Equipment and Operation.

Published Monthly by the
GLASS INDUSTRY PUBLISHING COMPANY, INC.
50 Church Street, NEW YORK

Telephones { Cortlandt 2465 / Cortlandt 5618 — Cable Address, Glasdustry

J. B. KRAK, Technical Editor

Subscription Price.....$2.00 a Year
Single Copy.....20 Cents

THE GLASS INDUSTRY circulates extensively among American and foreign glass manufacturers, their business executives and technical and factory operating staffs.

ADVERTISING RATES SENT ON REQUEST

Vol. 4 NEW YORK, JULY, 1923 No. 7

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Burdens of Industry

Notwithstanding the assurances from certain quarters that there is no reason to doubt a continuation of the present period of prosperity, there is among manufacturers an undercurrent of feeling that conditions do not warrant unlimited optimism. Leaving the economics of the situation to those qualified to judge, we venture to express the view of those engaged in manufacturing that industry at the present time is carrying extremely heavy burdens in the form of excessive taxation, high fuel prices, heavy costs of transportation and inefficiency of personnel. It is realized that unless these four items affecting costs can be reduced it will be a difficult matter to continue operation on the narrow margin of profit which prevails in many industries.

It has been a most cheering piece of news when announcement was made that the cost of running the government is decreasing and that the treasury this year will show a surplus instead of the deficit to which the country had become accustomed. It is certain that nothing could do more to increase confidence in the future than a realization that a general decrease of government expenditure has become a fixed policy. It is hoped that this will mark the beginning of a reduction of the spending mania which has affected federal, state and city government alike. The waste of public funds begun during the war and extended during the post-war years, the creation of numerous commissions to investigate at high cost problems more or less interesting, the unhappy experiments of the government in business, all have combined to make taxation far in excess of the legitimate needs of running the country. If government agencies were handled as a commercial proposition with men chosen for their ability rather than for their political affiliations taxes could assuredly be decreased and thousands of political drones would have to find useful employment.

To mention that manufacturing suffers greatly from the high fuel prices which prevail today is but the dreary repetition of a familiar complaint. But it cannot be stated too often that in order to have lasting prosperity it is urgent that the cost of fuel shall be decreased. There must be a solution of the fuel question, based upon justice to the mine owner, the coal miner and the consumer alike.

Quite as heavy as excessive fuel cost is the burden of high railroad transportation. While it is understood that railroading, like any other enterprise, shares in the difficulties which confront all industry, yet it is felt that the wages paid to railroad employees are out of proportion to those paid to labor of the same class engaged in work of no greater importance. Few if any manufacturers who really know what it is to do a day's work agree with the views recently expressed by Judge Gary with regard to the twelve hour day. But employers of labor feel that it is fair to demand a full day's labor for a full day's pay, and that the workers of today are on the whole inclined to consider this matter from their own point of view exclusively. It is still a common spectacle to see two or three men watching one or two others do a job. Although the improvement from war conditions is marked, there is still too much loafing on the job, and too much dissipation on the part of labor to be able to do justice to their work. Willingness to accomplish results on the part

of the individual, in government, in transportation and in industry will mean the solution of most of our present day troubles. When workers in whatever capacity they are employed can be made to realize that their own interests are identical with those of their employers, then and then only can a continuation of present day prosperity be expected.

Technical Consultation Service

THE GLASS INDUSTRY invites its readers to refer to this department any problems with which they may be confronted pertaining to raw materials, glass technology, laboratory and factory practice. While making no pretensions to the possession of unbounded knowledge or infallibility THE GLASS INDUSTRY is ready to assist its readers to the best of its ability in solving their problems. Readers who can offer better suggestions are invited to submit them.

Questions should be submitted in writing and will be answered by mail as promptly as possible. The sources of all inquiries will be held in strict confidence.

Question 50. Stones in Window Glass. We manufacture window glass and are always troubled more or less with stones. Using the following batch:

Sand	1000
Raw limestone powder	355
Soda	246
Salt cake	77
Coal	2 pounds

Answer.—With regard to your inquiry we should like to state that the proportions of the batch as given above are excellent, provided the raw materials used are pure. However, since the composition of the raw materials is not given, it is impossible to know definitely whether the proportions are such as to produce the best kind of window glass.

The elimination of stones is one of the most difficult problems with which glass makers have to contend. There are so many different kinds of stones, and they are due to such a variety of causes that it is impossible to give advice without a careful personal study of all conditions. Such a study would include an analysis of the raw materials, of the finished glass and of the stones, and a microscopic examination of the latter. While an analysis of stony glass is helpful to ascertain the cause of the trouble it is in itself not sufficient for a diagnosis.

Stones are sometimes due to excessive heat, which of course can only be guarded against by the use of pyrometers. On the other hand, lack of heat also may cause stones. It has been our experience that while it is impossible always to avoid stones, their appearance becomes less frequent when careful attention is paid to the composition of the batch and of the finished product, and when the furnace is properly managed. In other words, adequate control of the whole process of manufacturing will reduce stones (and all other troubles) to a minimum.—J. B. K.

Question 51.—Mold Paste.—Our present method of mixing mold paste, which we use in punch tumbler molds, does not appear to give the results that others appear to be obtaining on similar paste. We would appreciate any advice which you might furnish us with concerning the ingredients and mixing of paste suitable for this purpose.

Answer.—A mold paste formula which is entirely practical and easy to make consists of:

Linseed oil	2 pints
Cottonseed oil	1 pint
Bees wax	2 ounces
Shoemakers' wax	1 ounce

—I. E. A.

Standardizing Signal Coloring

Efforts are being made to establish standard colors for traffic signals, a movement which seems likely, eventually, to affect manufacturers of motor and signal lenses.

Forty-two men, representing the manufacturers and users of traffic signals, Federal and State governmental departments, associations interested in the prevention of traffic accidents, and representatives of the general public, are now at work on the drafting of a national code on the proper colors for traffic signals which it is expected will not only cut down the annual loss of life through traffic accidents, but will eliminate many of the existing irritations to motorists and to the operators of steam and electric railways.

This work is being carried on under the auspices of the American Engineering Standards Committee, whose approval of a code or standard insures its ultimate acceptance and observance throughout the country.

The sectional committee drafting this code is made up of seven representatives of the manufacturers of traffic signals, nine representaives of the purchasers of such equipment, three representatives of the users of traffic signals, twelve representatives of governmental bodies, five technical specialists, and six insurance representatives.

Charles J. Bennett, State Highway Commissioner of Connecticut, who represents the American Association of State Highway Officials, has been selected chairman of the sectional committee. M. G. Lloyd of the United States Bureau of Standards, who is the representative of both the bureau and the American Society of Safety Engineers, is vice chairman, and Walter S. Paine, research engineer of the Ætna Life Insurance Company, who is the representative of the National Safety Council, is Secretary.

New Books

THE FLOW OF GASES IN FURNACES. By W. E. Groume-Grjimailo, professor of iron manufacture at the Polytechnic Institute of Petrograd. Translated from the French by A. D. Williams, with an appendix upon the design of open-hearth furnaces, xxi and 399 pages, 9¼ x 6. Published by John Wiley & Sons, Inc., New York. Price $5.50.

This book is divided about equally beween a translation from the French edition of a well known Russian book on the "Flow of Gases in Furnaces," and a group of appendices by the translator and others, including many tables of great practical value in furnace design.

The first half of the book treats of the development of the flow laws of heated gases and the application of those laws to the rational design of furnaces, with an analysis of many defective designs of furnaces, the reason of their failure and the alterations made to secure successful operation.

The comparatively new idea, that of examining each furnace as a hydraulic recipient or reservoir, has exercised a deep influence upon the working out of new forms of furnaces, as regards the proper utilization of heat generated by the combustion of the fuel. The treatment is thoroughly practical, being based upon actual observations and experiments. A number of appendices were added by the translator in order to further enhance the usefulness of the book.

GLASS-MAKING IN ENGLAND, by Harry J. Powell, C.B.E. Royal 8vo. pp. x-184. With frontispiece, 106 illustrations, and a map. Price, 25 shillings net. Published by Cambridge University Press, London.

The late Mr. H. J. Powell wrote a book upon the craft of glass-making as an English fine art, a subject upon which the attention of his lifetime was focused. It was the outcome of his devotion to this old-time craft and of the experience which he gained as one of the partners in the well-known Whitefriars Glass Works, the last of the old glass houses to survive on its original site beneath the shadows of St. Paul's. The contents include: Roman glass in England, glass-making in England, contemporary records of glass-making in England, 1567-1700; English drinking glasses, old English bottles and flint-glass decanters, old London glass-houses, Provincial glass-houses, colored glass, cast plate-glass, flint glass, cut glass, the excise period, the international exhibitions of 1851 and 1862, extracts from the notes of a flint-glass works manager from 1875-1915, glass-making during the war, 1914-1918.

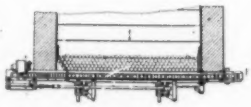
Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Copies of United States Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

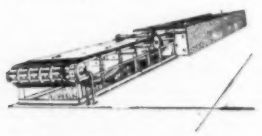
Lehr Feeder. U. S. 1,454,520. May 8, 1923. Benjamin H. Purcell, of Terre Haute, Ind., assignor to Automatic Machinery Company, of Terre Haute, Ind.

In the use of a lehr feeder of that type in which the ware is brought to the lehr by means of a constantly-moving belt, the ware is obstructed at the entrance side of the lehr while the feed belt continues in its movement, the ware accumulating in successive contact with each other, during a period sufficient to allow operation of the ejecting mechanism, the movement being in the line of movement of the lehr belt or pans. Difficulty has heretofore been experienced by reason of unusual breakage of the ware at the throat or entry end of the lehr, due to the fact that the massing of ware at the far side of the lehr requires, for a maximum packing of the lehr, too great a lateral movement of the ware on the lehr pans or belt.



The object of this invention is, to provide means for compensating the massing of the ware referred to. This the inventor claims to accomplish by means of a dam projecting across the feed carrier in position to interrupt the flow of articles upon said feed carrier arranged at a substantial distance in advance of the far side of the lehr carrier, and a laterally divergent guide extending from said dam forwardly and outwardly toward the far side of the lehr carrier to permit the articles of ware in the lehr entrance to shift about on one another, to properly space themselves as they are crowded forward by those introduced in the entrance from the feed carrier.

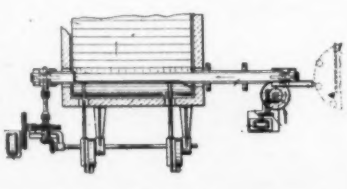
Apparatus for Cutting Sheet Glass. U. S. 1,453,856. May 1, 1923. Clifford A. Rowley and Joseph A. Reece, of Toledo, O., assignors to the Libbey-Owens Sheet Glass Company, of Toledo, O.



Among the inventor's claims is the combination with a conveyor for carrying a sheet of glass longitudinally, an automatic apparatus for transversely cutting the glass sheet, comprising a cutting tool, a carrier for the tool, means for drawing the tool across the sheet, means for moving the carrier with the sheet while the cutter is operating, and means for returning the parts to the starting position, and a timing mechanism for repeating the cycle of operations at spaced intervals.

Mechanism for Conveying Hot Glassware. U. S. 1,455,966, May 22, 1923. Michael J. Owens, of Toledo, O., assignor to the Owens Bottle Company, of Toledo, O.

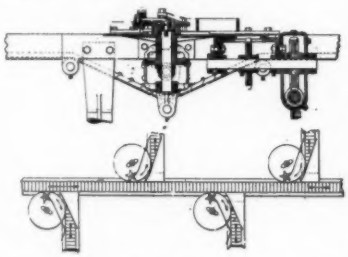
Bottles or other articles are delivered from the molds of a glass forming machine to an inclined chute down which they slide one by one onto a continuously rotating transfer disk or table by which they are transferred to a continuously running belt conveyor which extends from said table to and through the lehr. The carrying-in conveyor is driven by a motor through gears, shaft and pulley.



The transfer disk or table is located directly beneath the lower end of the chute and is rotated continuously about a vertical axis. The bottles or other articles drop from the chute onto this disk and are prevented from being thrown off the disk by a stationary guard. The bottles travel with the disk until arrested by a stationary deflector or guard so arranged that it deflects or cams the bottles onto the conveyor which is preferably in substantially the same horizontal plane as the disk. A motor is connected through gears to rotate the disk continuously.

Each bottle or other article as it slides from the chute onto the disk is carried by the latter out of the way of the next succeeding bottle and thus prevented from contacting therewith. They are also by the disk properly spaced on the carrying-in belt so that contact of one bottle with another is prevented until they have entered the lehr or have cooled sufficiently to prevent injury due to such contact.

Conveyor System. U. S. 1,457,364. June 5, 1923. George H. Hallock, George F. Frederick and Benjamin H. Purcell, of Terre Haute, Ind., assignor to Automatic Machinery Company of Terre Haute, Ind.

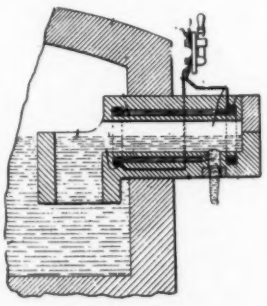


The object of this invention is to produce an apparatus by means of which articles, such as bottles, jars, cans, packages, etc., may be automatically delivered from one or more stations or sources, to a common carrier, the arrangement being such that the articles from the several sources may be kept from interfering with each other as they pass to and upon the common carrier.

Among other claims the inventors specify the combination with a main conveyor, of a feeding conveyer leading laterally to the main conveyor, a rotary transfer disk arranged in a corner between said conveyors for frictional reception of articles, means for rotating said disk, an obstructer arranged adjacent the disk in the line of travel of articles on the disk, means for normally restraining said obstructer in obstructing position, and means synchronized with the main conveyor for intermittently withdrawing the restraining means.

Feed Trough for Glass Furnaces. U. S. 1,458,522. June 12, 1923. Walter G. Clark, of New York, N. Y.

When a glass furnace is shut down and the heat withdrawn therefrom, that portion of the furnace from which the molten glass is withdrawn, and known as the feed trough or spout, is often filled with glass and becomes set.



When heat is reapplied to the main body of the furnace and the glass therein becomes molten, the trough is usually so far distant from the source of heat that some considerable period of time elapses after the glass in the body of the furnace has become molten, before the glass in the trough also becomes plastic enough to be withdrawn therefrom.

This invention provides additional advantages by the introduction of means whereby the glass in the trough may be kept at a high temperature through the introduction of supplemental heating means thereto, and from an entirely different source and manner, than the heat supplied to melt the glass mass in the body of the furnace.

The inventor claims in combination, a furnace; a feed trough therefor comprising a horizontal portion; an electric-resistance heating means associated with said trough and completely embedded in the walls thereof and extending substantially from end to end of the horizontal portion whereby to melt the glass within said trough; a second heating means comprising electrodes in communication with the interior of the trough at opposite ends thereof, whereby the glass may be maintained in molten state by passing a heating current through the molten glass; and a pair of controllable electric current supply means whereby current may be supplied at will to said resistance heating means or said second means or both.

Cylinder-Capping Device. U. S. 1,458,452. June 12, 1923. William Westbury, of Caney, Kansas.

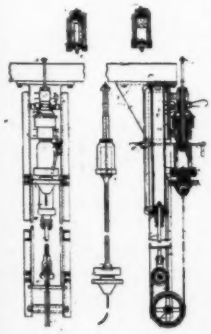
Very often a cylinder is drawn which is thicker on one side than on the other side. If, under such conditions, an ordinary electrically heated cracking wire is used the heat applied through the wire will cause the thin side of the cylinder to be burnt, producing checks or flaws, while the thick side of the cylinder is not heated sufficiently for a cracking off action.

If, under such conditions, the thick side of the cylinder should be heated sufficiently to crack off, the imperfections produced, as a result of an irregular cracking off action when the walls of the cylinder are of uneven thickness, are liable to cause the cylinder to break or "blow up" when the cylinder is handled or placed in the flattening oven. One object of this invention is to provide an electrically heated cracking device, including a resistance wire, and current controlling connections, whereby the current may be supplied to heat the entire wire or to heat only a portion of the wire at will, thus enabling the operator to apply the heat to the cylinder to compensate for variations in the thicknesses of different portions thereof.

A further object of the invention is to provide a cracking wire which will admit of the application of heat first to the thick side of a cylinder so that the same may be partially burnt through, and then to all portions of the cylinder encircled by the wire simultaneously, allowing a clean cracking action to be performed.

Glass-Tube Spinning and Drawing Apparatus. U. S. 1,458,518. June 12, 1923. Louis N. Bruner, of New York, and Simon D. Olsen of Brooklyn, N. Y.

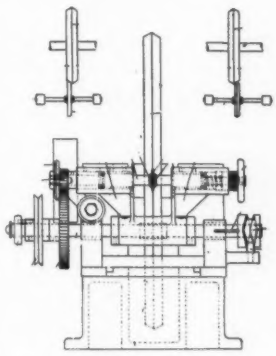
This invention has for its object to provide an improved apparatus and process whereby glass tubes of uniform bore may be easily and quickly made by machine without requiring skilled labor.



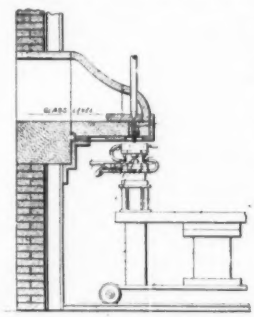
The operation of the device is very simple. Pressure medium is directed to the upper end of the cylinder thereby raising the upper draw-head, and the cap after which the draw-heads, which are of steel, are heated, as by blow torch or hot glass sufficiently to make the glass stick. The mold itself is made of cast iron and remains relatively cool so the glass will not stick. A charge of molten glass is then poured into the rotatable mold until the mold is about half full. By manipulating the handles the draw-head is then lowered and the cone raised, thereby closing and rotating said mold and locking the cap in place with the charge in the mold; thereby centrifugally to form a glass cylinder closed at the lower end, open at the upper end and enclosing an air-space therein. Next the cone is lowered, the cylinder thereby brought to rest, and the cap thereby unlocked. Pressure medium is then again directed to the upper part of the cylinder, thereby drawing upwardly said heads and said ends apart thereby to elongate said cylinder and to reduce its diameter; thereby producing a tube with a closed lower end. A slight cooling of the tube and the cutting off of its ends then completes the tube.

Machinery for Beveling the Edges of Glass Lenses and the Like. U. S. 1,457,855. June 5, 1923. Sidney Richardson, of Hatton Garden, London, England.

A feature of this invention, for the production of double bevelled edge lenses, consists in providing for the mechanical movement of the wheel and lens relatively to one another in a direction substantially parallel to the axis of the lens-carrying spindle so as to enable the bevel edges of the wheel to grind successively bevel edges of opposite inclination on the lens. This relative movement of the lens and grinding wheel may be made automatic and of a reciprocating nature so as to enable each bevel edge of the wheel to grind repeatedly but alternately on the periphery of the lens any desired number of times, until the edges of the lens have been ground to the required form and size.



Method of and Apparatus for Feeding Molten Glass. U. S. 1,458,167. June 12, 1923. Scott Davidson, of Hillsboro, Ill., assignor to Schram Glass Mfg. Co., of St. Louis, Mo.



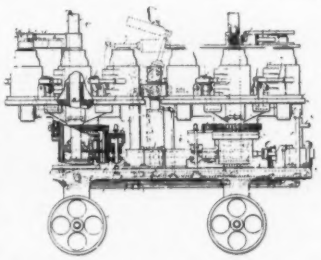
This invention relates to improvements in the method of and apparatus for feeding molten glass, and has for its primary object a one-piece or non-partible floating gathering cup, which is movable vertically and which can also be rotated.

Below the floating gathering cup is placed an adjustable guide lip, which is for the purpose of conducting the end or tail of the severed stream into the mold.

A still further object is the method of feeding molten glass into molds by imparting to it a sudden downward rotary motion, which frees it from the sides of the gathering cup and allows it to drop into the mold.

Glass-Blowing Machine. U. S. 1,458,454. June 12, 1923. James M. Young, of Anderson, Ind., assignor to Obear-Nester Glass Company, of St. Louis, Mo.

This invention relates to machines for blowing glassware such as the so-called "narrow neck" ware although it is to be understood that the same can be adapted for the manufacture of articles of other types.



Among the objects of this invention is to provide a machine in which all of the parts operate automatically in properly timed relation whereby to pack the metal about the neck pin, withdraw the neck pin from the blank, initially blow the blank, and then automatically open the mold to release the blank; to provide means operating in properly timed relation for holding and gripping the released blank and lifting it away from the blank mold, inverting it and automatically depositing it in an open blow or finishing mold; and to provide means for automatically closing the blow mold upon the deposited article, completing the blowing operation, and finally releasing the finished article to permit its ready removal from the machine.

Glass Factory Equipment and Supplies

THE GLASS INDUSTRY will be glad to publish descriptions of new and useful devices, machinery and supplies of interest to the glass manufacturing trade. Most of the information printed in this department comes direct from the manufacturers of the products described.

An Entirely Electrical CO_2 Recorder

By C. W. Campbell*

It is now generally recognized that the most reliable control of the products of combustion is effected by obtaining a continuous analysis of the flue gases, in order to determine the percentage of carbon dioxide which they contain. The best working results are obtained when the flue gases contain from 10 to 15 per cent. CO_2, the loss of fuel being approximately 18 to 14 per cent. When, as is the case in many present day power plants, only 7 to 8 per cent. of CO_2 is present in the flue gases, there is an actual loss of fuel of about 24 per cent. This shows the importance of having instruments which continuously and accurately measure the CO_2

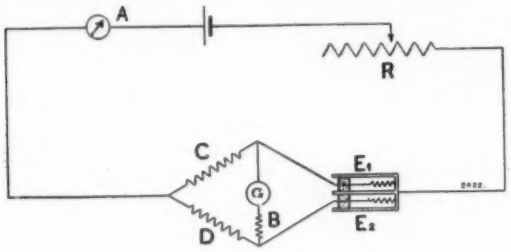


FIG. 1

percentage, and so enable the fireman and engineer to get the best results at a minimum cost.

Various types of instruments have been devised to this end, the majority depending for their action on the absorption of carbon dioxide by a substance such as caustic potash or lime. These instruments generally have delicate glass parts in their construction, and rubber connections which are liable to perish and so introduce air leaks. As they must necessarily be installed at some distance from the boiler, changes in the gas can only be recorded after a considerable interval of time, introduced by the length of the piping between flue and instrument. Also, when continuous measurements of CO_2 percentage at several points are desired, a separate instrument must be installed for each, so that a multi-point installation requires a considerable amount of attention.

FIG. 2

For these reasons the CO_2 indicator or recorder is often regarded as a luxury instead of being considered an essential part of the plant.

The instruments here described have been designed to measure CO_2 percentage by an electrical method which does not involve the use of any chemical reaction. The instruments are very robust in construction and possess the great advantage that, while the portion of the apparatus through which the flue gas passes is placed in close proximity to the flue, the indicator or recorder may be placed at any desired distance away, without introducing any additional time-lag.

The method employed is one which was devised by Dr. G. A. Shakespear of the University of Birmingham (England) for testing the purity of gases, and which has been applied to a number of purposes in addition to CO_2 work. It has been successfully applied to analyse simple gas mixtures in numerous chemical processes.

Two identical spirals of platinum wire are enclosed in two separate cells, E1, E2, in a metal block (Fig. 1), each of the spirals being connected to form one arm of a Wheatstone Bridge circuit, the other two arms, C, D, being of manganin. A small electric current is allowed to flow through the bridge, thereby causing the two spirals to become heated, this heat being lost to the walls of the cells by conduction through the gases contained in the cells. If the two cells contain gases having different thermal conductivities, the spirals will lose heat at different rates, and one spiral will therefore be maintained at a higher temperature than the other. This will result in a difference of resistance between the two spirals and will cause a deflection of the galvanometer, G, the extent of which depends on the difference in thermal conductivity of the two gases. The design is such that changes in the temperature of the gases affect both sides of the bridge equally. If, therefore, the cell E1 contains a pure gas,

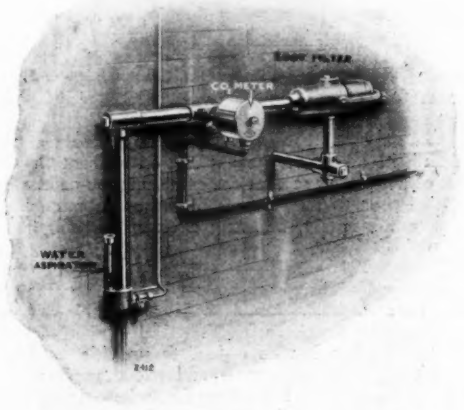


FIG. 3

and the cell E_2 the same gas mixed with some other constituent, the extent of the deflection will be an indication of the amount of the second gas present, and the galvanometer is calibrated to show directly the percentage composition of the mixture.

The difference in conductivity between air and carbon dioxide enables the method to be used for accurate determination of the percentage of CO_2 in flue gases. These gases consist chiefly of nitrogen and carbon dioxide mixed with small percentages of oxygen, water vapor, hydrogen, methane, and carbon monoxide. Since carbon monoxide, oxygen and nitrogen have all practically the same thermal conductivity, small variations of these gases do not affect the readings. The residual of hydrogen and methane is extremely small, and the effect of water vapor is counteracted in a very simple manner.

In practice, one cell is filled with air saturated with moisture, and the other is exposed to the gas under test. The difference in conductivity of the gases in the two cells then depends solely on the percentage of CO_2 in the gas.

Fig. 2 shows the CO_2 meter of which the essential part is the metal block containing the two cells in which are mounted the platinum spirals. The meter is screwed into the short pipe line-

*Cambridge & Paul Instrument Company of America, New York.

as shown in Fig. 3, the connection to the indicator or recorder being made by means of 4-conductor insulated cable.

Fig. 3 shows the compact arrangement of CO_2 meter, soot filter, water aspirator and piping which is possible. It will be obvious that the only time-lag experienced is that which is introduced by

FIG. 4

the short distance between the end of the flue gas intake pipe and the CO_2 meter.

The indicators supplied are robust instruments designed to have a long life under ordinary boiler house conditions. Standard indicators are supplied to centralize one, two, four, or six boilers on one instrument. Fig. 4 shows a 4-point indicator. The galvanometer movement is mounted in the upper portion of the substantial fume-tight case; the necessary switches and terminals are all entirely enclosed in the lower portion of the case.

Where continuous records are required, thread recorders are

FIG. 5

installed. These instruments have become widely known for satisfactory service under works conditions. Recorders can be supplied to give one, two, or four records on one chart. The standard 4-point recorder is shown in Fig. 5. These recorders can be arranged to show the flue gas temperature on the same chart with the CO_2 percentage.

It is frequently an advantage to have the CO_2 percentage indicated in the boiler room for the benefit of the fireman, while the record is obtained in the engineer's office. To fulfill these conditions combined indicating and recording outfits are supplied for one, two, or four boilers in which both indicator and recorder work off the same CO_2 meter on each flue.

The results obtained are accurate to well within 1 per cent. and are unaffected by rate of gas flow. The instruments can be used in connection with boilers heated by coal, oil, or gas.

Novel Instrument for Studying Mechanisms

An instrument, the Elverson oscilloscope, which can be used to advantage by makers and users of high speed machinery who desire to study the functioning of rapidly moving mechanisms, has been brought out by Herbert Kennedy & Company, Ltd., London, England.

The instrument produces to the eye an apparent effect of slowing down the motions under observation, sometimes as much as 99 per cent. of the true speed. Applied to a mechanism whose movement rotating or oscillating is 1,000 r.p.m., the movement can be followed at 10 r.p.m. By another use of the device, the motion may be apparently arrested at any point in the cycle of operations, and the phenomena at that point examined, although the mechanism is actually still operating at full speed. It is claimed that by means of the instrument imperfections in the working of any mechanism may be seen, and their causes disclosed.

A practical device of this kind would appear to have useful possibilities in connection with the study of glass feeders and other automatic machinery and in lubrication problems where the instrument is said to have disclosed some remarkable facts.

Thermolith

Thermolith, a highly refractory cement recently developed by the Harbison-Walker Refractories Company, Pittsburgh, Pa., possesses properties which, according to the manufacturers, make it especially suitable for use in the construction and repair of glass melting furnaces and lehrs.

Thermolith is a finely pulverized dry powder that is shipped in metal drums holding 200 pounds. It is mixed with water to a stiff mortar, in a water tight mortar box, and used like fire clay. It sets very hard when air dried, forming, it is claimed, a strong bond that is maintained up to its point of fusion, which is in excess of 3400 deg. F. It is practically a neutral cement and is said to be very little affected by the action of corrosive slags or destructive gases encountered in any type or kind of industrial furnace. The expansion of Thermolith under heat is practically the same as that of a first quality fire brick.

Business Publications

Oil Burning in Power Plants is the title of a new booklet which has just been issued by the National Airoil Burner Company, Ninth and Thompson streets, Philadelphia, Pa.

Link-Belt Electric Hoists and Overhead Cranes. A handsome book of 32 pages and cover, 8½ x 11 inch, in size, giving constructional details of direct and alternating current electric hoists and illustrating many applications of this and other equipment to the economical handling of materials. Link-Belt hoists, cranes and conveying equipment are used extensively in a number of the largest and most modern American glass factories.

Engineering Tables. Bulletin No. 118, the P. H. and F. M. Roots Company, Connersville, Ind. A new 32-page edition which contains many tables and other data designed to give complete information for making calculations for, and installations of blowers, pumps, exhausters and other equipment produced by the company, some items of which are used extensively in the glass industry. Included in the bulletin are charts, calculations and discussions pertaining to the flow of air and gas through pipes and orifices, oil burners, power requirements for Roots blowers, exhausters, pumps; calculations for gear drives, the flow of water in pipes, discharge of circular orifices or nozzles. The bulletin makes the work of the engineer easier by giving him a large amount of practical information divested of the superfluous information usually contained in text books.

Bureau of Standards Vacancies

Open competition examinations will be held throughout the country on September 5 by the United States Civil Service Commission for the purpose of filling vacancies in the Bureau of Standards. The examinations will be for laboratory assistants, junior grade, at $1,000 a year; senior aid, $900 a year, junior engineer, physicist and technologist at salaries ranging from $1,200 to $1,500 a year, junior aid, grade 1, $540 a year, grade 2, $700 to $840 a year. An increase of $20 a month recently authorized by Congress will be added to the salaries named above.

The Glass World and What It Is Doing

News of the Industry

Results of First Biennial Census of the Glass Industry

A report has just been issued by W. M. Steuart, Director of the Bureau of the Census presenting the results of the first biennial census of the glass industry, covering the calendar year 1921. The most important of the statistics were issued in November, 1922, in the form of a preliminary announcement, and were published on pages 258 and 259 of the December, 1922, issue of THE GLASS INDUSTRY. A few slight revisions have been made since the first announcement and for the convenience of readers the revised table of general statistics of the industry for 1921, together with comparative figures from the census of 1919, 1914 and 1909 is reprinted here.

Of the 329 establishments reported for 1921, 104 manufactured building glass; 128 pressed and blown glass; and 117 bottles and jars. Of the 371 reported for 1919, 128 manufactured building glass; 130 pressed and blown glass; and 145 bottles and jars. (The difference between the total numbers of establishments reported for each year and the total obtained by adding together the number of establishments manufacturing the several classes of products is accounted for by the fact that in some cases an establishment manufactures more than one class of products.)

It will be noted from the table on page 139 that 99 per cent of the total production for 1921 by value, came from 281 factories each of whose individual production ranged from $100,000 to $1,000,000 or over; while the 54 remaining factories produced only 1 per cent of the total value.

GENERAL STATISTICS FOR THE UNITED STATES, 1909 TO 1921

	1921 [2]	1919	1914	1909	Per cent of increase[1] 1919-1921	1914-1919	1909-1914
Number of establishments	329	371	348	363	—11.3	6.6	—4.1
Persons engaged	59,788	83,656	78,804	72,573	—28.5	6.2	8.6
Proprietors and firm members	47	60	93	87	—21.7	—35.5	6.9
Salaried employees	4,993	6,076	4,209	3,575	—17.8	44.4	12.7
Wage earners (average number)	54,748	77,520	74,502	68,911	—29.4	4.1	8.1
Primary horsepower	(3)	207,430	163,139	123,132	.....	27.1	32.5
Capital	(3)	$215,680,436	$153,925,876	$129,288,384	.....	40.1	19.1
Salaries and wages	$80,664,746	100,891,194	55,204,723	44,293,215	—20.0	82.8	24.6
Salaries	12,440,498	13,364,569	6,548,904	4,993,591	—6.9	104.1	31.1
Wages	68,224,248	87,526,625	48,655,819	39,299,624	—22.1	79.9	23.8
Paid for contract work	137,628	240,750	150,185	85,864	—42.8	60.3	74.9
Rent and taxes, including internal revenue	(3)	10,003,005	882,222	506,533	.....	1,033.8	74.2
Cost of materials	86,036,406	90,780,124	46,016,504	32,119,499	—5.2	97.3	43.3
Value of products	213,471,309	261,884,080	123,085,019	92,095,203	—18.5	112.8	33.6
Value added by manufacture [4]	127,434,903	171,103,956	77,068,515	59,975,704	—22.5	122.0	28.5

[1] A minus sign (—) denotes decrease.
[2] The figures for 1921 do not include 6 establishments with products valued at $16,500, each establishment reporting products under $5,000 in value. The figures for 1919, however, include 1 such establishment (for which data can not be given without disclosing its operations); those for 1914, 3 such establishments, with products valued at $5,927; and those for 1909, 11 such establishments, with products valued at $33,445.
[3] Not called for on schedule used for 1921.
[4] Value of products less cost of materials.

SUMMARY FOR THE UNITED STATES, 1849 TO 1921

Year	Number of establishments	Wage earners (average number)	Primary horsepower	Capital	Wages	Cost of materials	Value of products	Value added by manufacture [a]
				Expressed in thousands				
1921 [b]	329	54,748	(c)	(c)	$68,224	$86,036	$213,471	$127,435
1919	371	77,520	207,430	$215,680	87,527	90,780	261,884	171,104
1914	348	74,502	163,139	153,926	48,656	46,017	123,085	77,068
1909	363	68,911	123,132	129,288	39,300	32,119	92,095	59,976
1904	399	63,969	91,476	89,389	37,288	26,146	79,608	53,462
1899	355	52,818	52,943	61,424	27,085	16,731	56,540	39,809
1889	294	44,892	28,241	40,967	20,886	12,141	41,051	28,910
1879	169	24,177	5,672	18,805	[d]9,144	8,029	21,155	13,126
1869	154	15,367	1,857	13,826	[d]7,589	5,864	18,468	12,604
1859	112	9,016	.....	6,134	[d]2,904	2,914	8,775	5,861
1849	94	5,668	.....	3,402	[d]2,095	1,557	4,642	3,085

[a] Value of products less cost of materials.
[b] Figures for 1921 do not include data for establishments reporting products valued at less than $5,000.
[c] Not called for on schedule used for 1921.
[d] Includes salaries.

[1] The February, 1923, issue of the monthly Survey of Current Business shows (Table 41) the production of glass bottles and illuminating glassware to have been somewhat greater in 1922 than in 1921.

RELATIVE IMPORTANCE OF LEADING STATES, 1921

State	Number of establishments	Value of products: Amount	Value of products: Per cent distribution	Value of products: Rank[1]	Value added by manufacture: Amount	Value added by manufacture: Per cent distribution	Value added by manufacture: Rank[1]	Wage earners: Average number	Wage earners: Per cent distribution	Wage earners: Rank[1]
United States	329	$213,471,309	100.0	....	$127,434,903	100.0	....	54,748	100.0	....
Pennsylvania	89	65,674,768	30.8	1	37,980,651	29.8	1	16,706	30.5	1
West Virginia	72	35,508,740	16.6	2	21,813,449	17.1	2	8,589	15.7	2
Ohio	37	25,543,469	12.0	3	16,301,285	12.8	3	7,164	13.1	3
Indiana	31	21,430,313	10.0	4	10,525,187	8.3	4	5,550	10.1	4
Illinois	11	14,445,447	6.8	5	9,404,851	7.4	5	2,675	4.9	7
New York	19	13,415,677	6.3	6	8,529,962	6.7	6	3,060	5.6	6
New Jersey	14	12,988,611	6.1	7	8,204,054	6.4	7	4,073	7.4	5
Oklahoma	15	4,392,491	2.1	9	2,408,401	1.9	10	1,146	2.1	9
California	9	4,045,942	1.9	10	2,780,468	2.2	9	825	1.5	11
Maryland	6	2,910,982	1.4	11	2,184,257	1.7	11	1,108	2.0	10
All other States[2]	26	13,114,869	6.1	....	7,302,338	5.7	....	3,852	7.0	....

[1] Statistics for the State which ranks 8 in value of products, value added by manufacture, and wage earners can not be shown without the possibility of disclosing the operations of individual establishments.
[2] Arkansas, 4 establishments; Kansas, 4; Louisiana, 2; Massachusetts, 1; Michigan, 1; Missouri, 3; Rhode Island, 1; South Carolina, 1; Tennessee, 1; Texas, 2; Virginia, 3; Wisconsin, 2; and Wyoming, 1.

SIZE OF ESTABLISHMENTS, BY VALUE OF PRODUCTS 1921, 1919, AND 1914

Value of products, and census year	Establishments		Wage earners		Value of products	
	Number	Per cent distribution	Average number	Per cent distribution	Amount	Per cent distribution
United States:						
1921.....	[1]335	100.0	54,763	100.0	$213,487,809	100.0
1919.....	371	100.0	77,520	100.0	261,884,080	100.0
1914.....	348	100.0	74,502	100.0	123,085,019	100.0
Less than $5,000:						
1921.....	6	1.8	15	[2]	16,500	[2]
1919.....	1	0.3	[3]	[3]	[3]	[3]
1914.....	3	0.9	9	[2]	5,927	[2]
$5,000 to $20,000:						
1921.....	11	3.3	78	0.1	117,442	0.1
1919.....	12	3.2	[4]114	0.1	[4]159,539	0.1
1914.....	14	4.0	234	0.3	163,984	0.1
$20,000 to $100,000:						
1921.....	37	11.0	857	1.6	1,999,227	0.9
1919.....	33	8.9	874	1.1	1,950,021	0.7
1914.....	52	14.9	2,424	3.3	3,306,884	2.7
$100,000 to $500,000:						
1921.....	168	50.1	15,222	27.8	44,067,213	20.6
1919.....	186	50.1	19,999	25.8	51,221,495	19.6
1914.....	210	60.3	[5]	[5]	48,813,320	39.6
$500,000 to $1,000,000:						
1921.....	56	16.7	11,354	20.7	38,186,442	17.9
1919.....	70	18.9	16,723	21.6	49,235,395	18.8
1914.....	46	13.3	[6]52,620	[6]70.6	30,110,455	24.5
$1,000,000 and over:						
1921.....	57	17.0	27,237	49.7	[1]29,100,985	60.5
1919.....	69	18.6	39,810	51.4	159,317,630	60.8
1914.....	23	6.6	19,215	25.8	40,684,449	33.1

[1] Includes establishments reporting products valued at less than $5,000.
[2] Less than one-tenth of 1 per cent.
[3] Included in group "$5,000 to $20,000."
[4] Includes group "Less than $5,000."
[5] Included in group "$500,000 to $1,000,000."
[6] Includes group "$100,000 to $500,000."

Other data contained in the Census Bureau's pamphlet cover the production of glass 1909 to 1921 by kind, quantity and value; the value of products by class for selected states, 1909 to 1921; wage earners employed by months, 1921; detailed statistics for 1921, 1919 and 1914, giving data concerning the number and distribution of establishments, proprietors, salaried employees, wage earners, salaries and wages, cost of materials, value added by manufacture and so forth.

Copies of the pamphlet may be obtained from the Superintendent of Documents, Washington, D. C., at 5 cents each.

Illinois Glass Company Answers Complaint

An answer has been filed by the Illinois Glass Company to the complaint issued on April 9, 1923, by the Federal Trade Commission in which it was charged that the company had violated the laws against restraint of trade by buying capital stock of certain other companies, including the Illinois-Pacific Glass Company, of California, the Woodbury Glass Company, an Indiana corporation, the Chicago Heights Bottle Company and the Thompson Bottle Company, of Indiana, the Cumberland Glass Manufacturing Company, the More-Jonas Glass Company and the Minotola Glass Company, all of New Jersey.

The control of these companies, it is alleged, has tended to make the Illinois Glass Company an important and controlling factor in the glass bottle business of the United States, and enabled it to lessen competition and restrain commerce and tends to create a monopoly.

In its answer to the complaint the respondent admits that it acquired during the year 1902, 1400 shares of the capital stock of the Illinois-Pacific Glass Company of California, but alleges that such shares so acquired constitute not to exceed 28 per cent. of the outstanding shares of the Illinois-Pacific Glass Company.

Respondent admits that during the years of 1905 and 1910, respondent acquired 501 shares of the capital stock of Woodbury Glass Company, but alleges the fact to be that during and prior to said years respondent purchased and resold large quantities of ware manufactured by the Woodbury Glass Company, and that the purchase by it of such shares was for the purpose of furnishing additional working capital to the Woodbury Glass Company needed to enable said company to supply the requirements of respondent for such classes of ware. Respondent further alleges that in the year 1918, it, the respondent, sold and disposed of said shares and that since said sale has had no interest of any character in the said Woodbury Glass Company.

Respondent admits that during the years of 1904 to 1913, it acquired all the outstanding shares of the capital stock of Chicago Heights Bottle Company. Respondent alleges that for many years prior to 1913, and during the year 1913 and continuously thereafter, respondent purchased practically the entire out-put of said Chicago Heights Bottle Company and sold and marketed the same in the name of respondent. Respondent further alleges that the product manufactured by said Chicago Heights Bottle Company is a class of ware not manufactured at the remaining plants of said respondent.

Respondent admits that being desirous of acquiring additional manufacturing facilities, it acquired all of the outstanding shares of the capital stock of the Thompson Bottle Company, and alleges that all of the assets, properties and plant facilities of said Thompson Bottle Company, which were conveyed and transferred to respondent, have been continuously operated by and in the name of respondent as a part of its manufacturing facilities. Respondent further alleges that said plant formerly owned by said Thompson Bottle Company has been largely rebuilt and re-equipped since the year 1913 by respondent, at an expenditure in excess of $1,000,000. Respondent further alleges that the said Thompson Bottle Company was during the year 1914 duly dissolved pursuant to the laws of the State of Indiana.

Respondent specifically denies the purchase of said shares of stock hereinbefore recited has tended to make respondent a controlling factor in the glass bottle business in the United States, but to the contrary respondent states that at all of its plants, including those so acquired, it manufactured at the date hereof less than 20 per cent. of the glass bottles manufactured in the United States.

Respondent admits that on and for many years prior to the 29th day of December, 1919, Cumberland Glass Manufacturing Company was in active competition with respondent throughout certain states of the United States, but specifically denies that the said More-Jonas Glass Company or the Minotola Glass Company was so in active competition at any time with respondent.

Respondent alleges and states that during the year 1919 on account of the growth of the sales of its products in the Eastern States of the United States and by reason of excessive and increasing freight rates from its plants in Illinois and Indiana to such eastern points, it was compelled to seek eastern plant facilities and purchased the plants of the Cumberland Glass Manufacturing Company and of its subsidiaries and thereby avoided the necessity of the erection of a plant at the then high construction cost. Respondent admits that it acquired the title to all of the assets and properties (excepting cash on hand and in bank and certain securities) of the Cumberland Glass Manufacturing Company the More-Jonas Glass Company, and the Minotola Glass Company, and alleges that continuously to the date hereof, the said assets, properties and plant facilities so acquired were held and operated by the respondent. Respondent specifically denies that it at any time purchased or acquired any shares of the capital stock of the Cumberland Glass Manufacturing Company, or any interest in the shares thereof.

Respondent further alleges that the More-Jonas Glass Company was dissolved and its charter surrendered to the State of New Jersey on December 30, 1921, and that the Minotola Glass Company likewise dissolved and its charter surrendered to the State of New Jersey on December 19, 1921. Excepting as hereinabove recited, the respondent specifically denies that it at any time purchased or acquired any shares of the capital stock of either the said More-Jonas Glass Company or the said Minotola Glass Company. Respondent further alleges that since it acquired title to and obtained possession of said assets and properties, it has almost wholly rebuilt and re-equipped said plants at an expenditure in excess of $1,800,000.

West Virginia Gas Law Unconstitutional

The "Steptoe Law" which was passed in 1919 by the West Virginia Legislature with the object of preventing the exportation of natural gas from that state to others, especially the adjoining states of Pennsylvania and Ohio, has been declared unconstitutional by the United States Supreme Court.

Libbey-Owens' New Polished Plate Plant

The immediate construction of a factory for the ultimate production of 15,000,000 square feet of polished plate glass annually was announced on June 13 by E. D. Libbey, president of the Libbey-Owens Sheet Glass Company, Toledo, O., who stated that the board of directors had authorized the letting of construction contracts at once.

New methods and a new type of machine for grinding and polishing the glass developed by the Company during the past year will be used in connection with Libbey-Owens machines for flat-drawing heavy sheet.

The new plant will be built in East Toledo, closing negotiations for the purchase of the 117-acre Rideout farm on the main line of the New York Central at its junction with the Hocking Valley having been taken up immediately after the directors' decision by the E. H. Close Company which representated the Libbey-Owens Company in the purchase of the property. The DeVore Company of Toledo, are the engineers in charge of the preparation of plans for the huge new works, the completion of which will add immensely to Toledo's already great reputation as a glass producing center.

Germans May Build Factories Here

Three German bankers, Rudolf Rosenheim, said to be affiliated with the Stinnes group, Martin Sternberg, and Curt Sorbeim, arrived in New York on June 19 and according to an interview printed in *The Sun and The Globe* expressed their intention of establishing in this country several factories, including a glass works, to replace those they say are facing ruin in Germany. They are firmly convinced that Germany is headed for the rocks, going to pieces, and say that her financial giants are turning to the United States for future activities. Mr. Rosenheim said he and his associates will open factories here to make cosmetics, mouth-washes, soaps, tooth paste and other chemical products. Last year, he said, one company sold in 78 countries, 40,000,000 bottles of mouth-wash alone, and that one of their bottle factories in Germany employs 3,000 men.

Window Glass Case Comes Up November 12

A motion for the advancement of the case of the National Association of Window Glass Manufacturers, the National Window Glass Workers, et al, in their appeal from the decision of the United States District Court for the Northern District of Ohio, which granted a permanent injunction against the appellants, was filed June 4 in the United States Supreme Court at Washington, D. C. On June 11, the Court granted the motion and set November 12 as the day for arguing the case.

This is the case arising under the Sherman Anti-Trust Act and involving the associations named above and a large number of window glass manufacturers and other individuals.

Summer Meetings and Conventions

The usual Summer meetings of various glass manufacturers' and workmen's associations will take place as follows:

American Flint Glass Workers' Union, annual convention, Baltimore, Md., July 2. Glass Bottle Blowers' Association, annual meeting, Chicago, Ill., July 2.

American Association of Flint and Lime Glass Manufacturers, annual meeting, Atlantic City, July 16.

National Association of Manufacturers of Pressed and Blown Glassware, annual meeting, July 16 and 17, and wage scale meetings with representatives of the American Flint Glass Workers' Union, July 18.

Glass Container Association, meeting, Atlantic City, July 27.

American Ceramic Society Meetings

The Summer meeting will be held at Toledo, O., Detroit, Mich., and vicinity, August 8, 9, 10 and 11. The program has not yet been announced but members are assured that a pleasant and profitable round of activities will be provided.

A fall meeting will be held in connection with the National Exposition of Chemical Industries, week of September 17. New York City. Wednesday, September 19, is Ceramic day. The society plans a profitable technical program.

The 1924 Annual Convention will be held at Hotel Traymore, Atlantic City, February 4, 5 and 6.

The membership of the Society continues to grow larger. On May 14 it had passed the 2000 mark with 1775 personal members and 233 corporate members.

Glass Sand Specifications

The proposed tentative specifications for silica sand for glass making which was prepared by the Committee on Standards of the Glass Division of the American Ceramic Society in co-operation with the Bureau of Standards has been submitted by the Committee for discussion. The specifications cover character of sand, packing, impurities, screening, washing, percentage composition of various qualities, percentage tolerances allowed in composition, limits of size of sand grains, methods of testing and analysis. The specifications are given in the *Journal of the American Ceramic Society*, Vol. 6, No. 6, June, 1923, pages 180 to 184.

New Basis for Quotations on Soda Ash

Announcement has been made by H. G. Carrell, sales manager of Wing & Evans, Inc., New York, sales agent for the Solvay Process Company that their quotations on soda ash will, hereafter, be made on the basis of 100 pounds flat; that is, as shipped.

This method supersedes the old practice of quoting soda ash on the basis of 48% Na_2O, and the change is made in the interests of a better understanding between buyer and seller in the marketing of this product.

Sample Fair Featuring Glass

The Seventh International Sample Fair of Prague, Czechoslovakia, will be held September 2 to 9, 1923. At the Spring Fair last March there were 2,053 exhibitions of which the glass group included 71 manufacturers of glass, porcelain and ceramics. It was attended by about 90,000 persons, many being from abroad. Full particulars of the fair may be obtained from the "Bohemia" International Forwarding Company, Ltd., 59 Pearl street, New York.

Trade Restriction Alleged

A complaint issued May 16, 1923, by the Federal Trade Commission against the Hygrade Lamp Company, Salem, Mass., charges that company with violations of the laws against unlawful restraints and monopolies and with lessening competition by purchasing all the outstanding common capital stock and eight shares of the preferred stock of the Lux Manufacturing Company, Newark, N. J. A hearing will be had in the case on July 5.

Verified News of Trade Activities

The next **Pittsburgh Exhibit** of glass and pottery will be held January 7 to 28, 1924.

The Davies Glass & Manufacturing Company started operations in its new plant at Martins Ferry, O., on June 4.

The capital stock of the **Johnston Glass Company,** manufacturers of window glass, etc., Hartford City, Ind., has been increased from $325,000 to $700,000, with $200,000 preferred stock.

Wm. J. Miller, Swissvale, Pa., announces that owing to increased demands for automatic feeders and machines it has become necessary to enlarge both the day and night turn forces. Their new 40 by 73 foot addition is nearly completed, and will soon be ready for occupancy.

The Conroy-Prugh Glass Company, Pittsburgh, Pa., manufacturers of mirrors and dealers in polished plate and window glass, has let the contract for a new reinforced concrete and brick building, 60 by 130 feet. The building will cost $90,000 exclusive of machinery, heating system, etc.

Meth Glass Service Company. Application is being made for a Pennsylvania charter for this company by B. F. Hazelton, Jr., C. E. Frazier, Max Meth, C. S. Budd and others, the character and object of the company's activities being to render service to glass companies and other manufacturing companies in bettering their products and lessening the cost of their manufacture.

The Citizens Window Glass Company, New Bethlehem, Pa., has been organized with a capital stock of $100,000 to succeed the New Bethlehem Window Glass Company. Repairs to the plant have been completed and it is expected that it will be in operation early in August. The incorporators of the new company are: H. E. Andrews, C. C. Gumbert, Thomas Spillane, W. H. Hutchison, I. E. Lower, D. F. Cribbs and R. R. Anderson.

The Interstate Window Glass Company's factory at Smethport, Pa., has been closed down for repairs. The company states that the equipment in the blowing department is being so reconstructed as to increase production about 10 per cent. A new flattening oven is being installed and the size of another oven increased. Four new cutters' stalls are also being erected and an addition is being made to the warehouse which will increase the storage capacity about 25 per cent.

General Glass, Inc., Room 405, Powers Building, N. Y., has been incorporated to manufacture plate glass by a new process, the invention of C. O. Northwood, of Clyde, N. Y. The following men are said to be interested: Henry J. Crowder, Earl H. Crowder, Dr. M. A. Morris and Louis E. Fuller. Press reports state that the company has acquired the plant of the Geneva Glass Products Company, at Geneva, N. Y., which is equipped for making window glass, bottles and other glass products.

New Glass Company Formed in Prague. A new company under the title of "Resista" has just been formed at Prague, Czechoslovakia, to manufacture the so-called unbreakable glass invented by Dr. V. Horak at the time he was general manager of the Cavalier Glass Company, at Sazava Buda, which company manufactures a somewhat similar glass under the trade name "Silex." The new Resista Company is capitalized at 1,200,000 crowns (6,000 shares at 200 crowns each), the crown being worth $0.0298 at present exchange. (Trade Commissioner H. L. Groves, Prague, April 14.)

Unconfirmed press reports state that **The Louisiana Glass and Manufacturing Company,** backed largely by glass manufacturers of the territory around Lancaster, O., will start July 1, the construction of a $250,000 glass manufacturing plant in Ouachita parish, a short distance from Monroe. James S. Stock, of Lancaster, O.; James E. Ensel of Steubenville, O.; E. L. Rapp of Lancaster, O.; John S. Giannone of Jacksonville, Ala., and Homer C. Fiser of Monroe, are the leading officials of the new company. It is reported that the plant will be completed and will employ 200 workmen within 6 months.

The consolidation of three large glass factories, the Federated Glass Company, the L. J. Houze Convex Glass Company and the Houze Window Glass Company, all of Point Marion, Pa., into the **L. J. Houze Glass Company,** was effected at a special meeting of the stockholders of all companies concerned held on May 29. The officers of the new company are L. J. Houze, president; A. L. Houze, vice-president; R. J. Houze, secretary and treasurer, and W. H. Board, assistant secretary and treasurer. The products of the company will consist of colored glass specialties and optical glass and it is expected that the merger will facilitate more economical production.

Personals

H. R. N. Johnson, who formerly represented the Uehling Instrument Company in Minnesota and the Dakotas, has joined the W. P. Nevins Company, 120 South Ninth street, Minneapolis, Minn., which company is now the official Uehling representative in the territory mentioned.

Raymond B. Ladoo, well known to the ceramic industries through his work on minerals in the Bureau of Mines, from which he recently resigned, is now general manager of the Southern Minerals Corporation, Cleveland, Tenn., with offices in the Continental Trust Building, Washington, D. C., and branch offices at Waterbury, Vt., and Burlington, Vt. Mr. Ladoo will give special attention to non-metallic minerals.

Death

William H. Frink

William H. Frink, well known in the glass and ceramic industries, died of apoplexy at his home in Lancaster, O., on May 29, 1923, in his seventy-third year. Funeral services were held at the home on May 31. Interment was made at Quality Hill, Canastota, N. Y.

Mr. Frink was a native of New York State and for a number of years acted as master mechanic for the United Glass Company, of Cleveland, N. Y. He then entered the employ of the American Window Glass Company in the capacity of master mechanic. In 1907 Mr. Frink became affiliated with his sons, Robert L. Frink and Fred J. Frink, in the promotion and exploitation of the Frink window glass machine patents, and in the development and sale of pyrometer equipment, glass decolorizer and other products developed in the Frink laboratories in Lancaster.

Mr. Frink was married in 1871 to Miss Laura Luella Leonardson, who survives him, as do his two sons, Robert L. Frink, Director of Research for the British Glass Industry, and Fred J. Frink, Director of The Frink Pyrometer Company and the Frink Decolorizer Company.

Inquiries Received

For further information address THE GLASS INDUSTRY

138. Can you give us the name of the company manufacturing 3/16 inch glass, the trade mark and name of which is Pelican Plate.

139. We are in the market for 2 and 3 ounce jars, similar to those used for cold cream.

140. Kindly send us the names of concerns who can cast flint glass bases weighing about one pound each for a show counter advertising fixture. Will require at least 50,000 castings per year.

141. We use annually about 2,000 beveled glass Bezels, 11¼" dia., 3/16" thick, for Venturi meters. Also 1,000 counter glasses, 1/16" thick, oblong shape, not beveled. Please put us in touch with sources of supply.

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Pa.)

PITTSBURGH STOCK EXCHANGE, JUNE 22, 1923

	Bid	Ask	Last
American Window Glass Machine, common	80	81	80
American Window Glass Machine, preferred	90	91	92
American Window Glass preferred	106	..	107
Pittsburgh Plate Glass	167	170	168
U. S. Glass	28	28½	29

A quiet market prevailed for the glass stocks during the past month. U. S. Glass was the most active of the group and slightly strengthened its price undertone. On American Window Glass Machine preferred a quarterly dividend of 1½% was declared payable on July 2, to stock of record June 15th.

WHEELING STOCK EXCHANGE, JUNE 22, 1923

	Bid	Ask	Last
Hazel-Atlas	37	37½	37½
Imperial Glass	98	99½	99
Fostoria Glass	139	..	140
Central Glass	90	95	90

There was practically no change in the glass group from a month ago. Hazel-Atlas was quite active, but maintained approximately the same price level. The quarterly dividend on Imperial of 1½% was declared payable July 2 with the books closing June 23.

TOLEDO STOCK EXCHANGE, JUNE 22, 1923

	Bid	Ask	Last
Owens Bottle Machine, common	41	42¾	..
Owens Bottle Machine, preferred	107	110	..
Libbey-Owens Sheet Glass, common	130	140	..
Libbey-Owens Sheet Glass, preferred	102	106	..

Current Prices of Glass-Making Materials

Quotations furnished by various producers, manufacturers and dealers

June 23, 1923		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½	.05
Aluminum oxide (Al_2O_3)	lb.	.06½	.07
Antimony oxide (Sb_2O_3)	lb.	.07	.07½
Arsenic trioxide (dense white), 99% (As_2O_3)	lb.	.13¾	.14½
Barium carbonate ($BaCO_3$)	ton	70.00	90.00
Barium hydrate ($Ba(OH)_2$)	lb.	.05½	.05¾
Bone ash	lb.	.07	.07½
Borax ($Na_2B_4O_7\,10H_2O$)	lb.	.05½	.06
Borax, fused, any mesh ($Na_2B_4O_7$)	lb.	.19	.20
Boric acid, fused (B_2O_3)	lb.	.35	.35
Cadmium Sulphide, red (CdS)	lb.	..	1.65
Cadmium Sulphide, orange	lb.	..	1.65
Cadmium Sulphide, yellow (CdS)	lb.	..	1.85
Chrome oxide	lb.	.35	.36
Cobalt oxide, in bbls. (Co_2O_3)	lb.	..	2.10
Cobalt oxide, in 10 lb. tins (Co_2O_3)	lb.	..	2.20
Copper oxide, red	lb.	..	.15-.16
Copper oxide black (CuO)	lb.	..	.26
Copper oxide, black prep'd (CuO)	lb.	..	.30
Cryolite (Na_3AlF_6)	lb.	.09	.09½
Feldspar, 100 mesh	ton	11.50-16.00	20.00
Fluorspar, powdered white, 95% (CaF_2)	ton	48.00	60.00
Fluorspar, powdered white, 90% (CaF_2)	ton	45.00	55.00
Hydrofluoric acid (HF) 60% (in lead carboys)	lb.	.13	..
Kaolin (f.o.b. mine)	ton	10.00	20.00
Lead oxide (red lead) (Pb_3O_4)	lb.	.11½	.11¾
Litharge (PbO)	lb.	.11	.11¼
Lime—			
Hydrated (in 50 lb. paper sacks) ($Ca(OH)_2$)	ton	12.50	..
Burnt, ground, in bulk (CaO)	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground in 280 lb. bbls. per bbl.		2.15	2.30
Manganese 85% (MnO_2)	lb.	.03½	.04
Nickel oxide, black (Ni_2O_3) for nickel content	lb.	.32	..
Nickel monoxide, green (NiO) for nickel content	lb.	.30	..
Potassium carbonate—			
Calcined 90% (K_2CO_3)	lb.	.06½	.07
Hydrated 90% (KOH)	lb.	.07	.07¼
Potassium nitrate (KNO_3) (gran.)	lb.	.06½	.06¾
Potassium Permanganate ($KMnO_4$)	lb.	..	.17
Powdered blue	lb.	..	.24-.26
Powdered blue (std. formula)	lb.	..	.38
Salt cake, glassmakers, f. o. b. works (Na_2SO_4)	ton	25.00	35.00-40.00
Selenium (Se)	lb.	..	2.10-2.85
*Soda ash (Na_2CO_3) dense, 58% Bulk	100 lb.	1.47	..
Bulk, on contract	100 lb.	1.42	..
Soda ash (Na_2CO_3), 58% dense, 48% basis Bulk	100 lb.	1.22½	..
Bulk, on contract	100 lb.	1.17½	..
Sodium nitrate, refined ($NaNO_3$)	lb.	..	.04¾-.05¼
Sodium selenite (Na_2SeO_3)	lb.	1.90	2.00-2.50
Sodium Fluosilicate (Na_2SiF_6)	lb.	.07¾	.08½
Sulphur (S) (flowers)—in bbls. per 100 lb.		3.25	3.55-3.80
Sulphur (flowers) Bags per 100 lb.		3.00	3.30-3.55
Sulphur (S) (flour, heavy), in bbls. per 100 lb.		2.50	3.00
Uranium oxide—100 lb. lots (UO_3)	lb.	..	2.25
Zinc oxide (ZnO)	lb.	.08¼	.08½

*Announcement has been made by H. G. Carrell, sales manager of Wing & Evans, Inc., New York, sales agents for the Solvay Process Company that their quotations on soda ash will hereafter be made on the basis of 100 pounds flat; that is, as shipped.

This method supersedes the old practice of quoting soda ash on the basis of 48% Na_2O, and the change is made in the interests of a better understanding between buyer and seller in the marketing of this product.

Monthly Summary of United States Foreign Commerce in Glass

Exports

Corrected to May 23, 1923

	April 1922 Quantity	April 1922 Value	April 1923 Quantity	April 1923 Value	Ten Months Ending February 1922 Quantity	Ten Months Ending February 1922 Value	Ten Months Ending February 1923 Quantity	Ten Months Ending February 1923 Value
Glass and glass products (total)	.....	$725,878	.....	$1,024,073	.....	$7,157,993	.....	$7,878,397
Plate and window glass—								
Window glass, common, box 50 sq. ft.	4,466	$23,785	4,935	$28,413	20,977	$122,455	27,980	$159,995
Plate glass, unsilvered, sq. ft.	280,632	120,279	237,100	102,175	2,052,247	920,774	1,827,336	720,144
Other window and plate glass, n. e. s. lbs.	97,411	13,413	403,858	42,298	[2]564,776	[2]58,870	2,620,450	276,852
Glass containers (bottles, vials and jars) lbs.	2,953,208	173,335	6,625,561	318,342	.....	1,937,082	47,080,684	2,383,529
Table glassware, plain lbs.	892,347	103,902	1,818,894	187,178	[2]2,400,324	[2]313,198	15,266,021	1,588,038
Table and other glassware, cut or engraved lbs.	68,198	19,419	54,110	17,165	.....	110,529	477,573	182,205
Glassware for lighting—								
Lamp chimneys and lantern globes lbs.	94,173	21,230	160,645	32,295	[2]421,312	[2]89,883	1,312,071	257,034
Globes and shades for lighting fixtures lbs.	165,507	42,110	107,480	34,340	[2]452,154	[2]131,052	1,278,217	367,217
Lamps and other illuminating devices, chiefly of glass lbs.	118,606	38,181	169,533	39,483	[2]434,821	[2]163,427	1,049,355	307,026
Chemical glassware lbs.	16,157	14,434	17,753	13,737	.....	133,310	174,841	120,446
Electrical glassware, except for lighting lbs.	143,270	9,736	250,155	13,401	[2]449,551	[2]58,383	2,546,507	163,680
Other glassware, n. e. s. lbs.	1,596,548	146,054	1,233,186	195,256	.....	3,119,030	7,703,435	1,352,231

[2] Jan. 1 to Apr. 30.

Imports

[NOTE—Owing to continued delay in the compilation of import figures the reports for February and March given below are the latest available.]

Corrected to June 1, 1923

	Feb. 1923 Quantity	Feb. 1923 Value	March 1923 Quantity	March 1923 Value	Nine Months Ending January 1922 Quantity	Nine Months Ending January 1922 Value	Nine Months Ending January 1923 Quantity	Nine Months Ending January 1923 Value
Glass (total)	.....	$1,511,530	.....	$1,727,459	.....	$6,961,468	.....	$12,996,061
Cylinder, crown, and sheet, lbs. dut.	.....	.....	.....	.....	35,606,904	$1,773,255	[1]12,319,638	[1]$560,973
Unpolished, lbs. dut.	2,866,327	$105,538	$4,095,393	$162,916	.....	.....	[2]21,253,451	[2]901,662
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	29,808	.....	78,954	.....	.....	.....	[2]351,170
Plate glass—								
Unsilvered, sq. ft. dut.	1,912,317	1,064,531	1,954,825	1,032,470	3,226,654	1,672,991	13,149,985	6,602,147
Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft. dut.	206,139	32,022	184,385	17,288	.....	.....	[2]1,159,768	[2]192,937
Containers—bottles, vials, etc. dut.	.....	14,491	.....	53,302	.....	264,637	.....	268,680
Table and kitchen utensils, lbs. dut.	56,473	14,653	18,099	7,916	.....	.....	[2]472,347	[2]174,425
Glassware, cut or decorated, lbs. dut.	72,846	50,847	191,466	86,504	.....	1,197,409	.....	1,277,064
Blown glassware, n. e. s., lbs. dut.	221,445	65,303	461,539	90,201	.....	.....	[2]2,580,735	[2]595,515
Other glassware { dut.	.....	.....	.....	.....	.....	202,934	.....	144,253
Other glassware { free	.....	134,337	.....	197,908	.....	1,850,242	.....	2,027,235

[1] July 1 to Sept. 21. [2] Beginning Sept. 22.